DOE/EIS-0218F
February 1996

Volume 2

FINAL ENVIRONMENTAL IMPACT STATEMENT

on a

Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel

Appendix D
Selection and Evaluation of Potential Ports of Entry

United States Department of Energy
Assistant Secretary for Environmental Management
Washington, DC 20585

Table of Contents

List of Figures

List of Tables

Appendix D
Selection and Evaluation of Potential Ports of Entry

This appendix describes the process used by the Department of Energy (DOE) in selecting the potential ports of entry analyzed in this Environmental Impact Statement (EIS). In addition, the appendix provides the basic information required to evaluate ports and port activities, and the potential environmental impacts (incident-free and accidents) associated with the receipt and handling of foreign research reactor spent nuclear fuel from vessels to intermodal transport in ports.

D.1 Ports of Entry Selection Process

The adopted port selection process was based on a set of criteria developed by DOE to identify those ports that would be most capable of providing for the safe receipt, handling, and transhipment of foreign research reactor spent nuclear fuel. This appendix first describes the process through which DOE developed the port selection criteria, and then describes the application of the criteria, resulting in the identification of the specific ports available for consideration.

Because the basic implementation of Management Alternative 1 of the proposed action would involve shipments from many foreign countries to several potential foreign research reactor spent nuclear fuel management sites in addition to those identified in the Environmental Assessment of Urgent-Relief Acceptance of Foreign Research Reactor Spent Nuclear Fuel (DOE, 1994d), it was necessary to expand on the port analysis approach used in the Urgent Relief Environmental Assessment. The Urgent Relief Environmental Assessment was concerned with fewer shipments within a short timeframe, with the shipments going only to the Savannah River Site. Also, as stated in the Urgent Relief Environmental Assessment, this EIS considers future population trends and future port developments.

Independent maritime safety experts consulted during the preparation of this EIS informed DOE that any modern breakbulk or container terminal can accommodate the safe receipt, handling, and transhipment of foreign research reactor spent nuclear fuel in approved shipping casks (USMMA, 1994). This view is supported by the well-documented excellent safety record for shipping foreign research reactor spent nuclear fuel in the United States (NRC, 1993). In addition, the port selection criteria discussed in this appendix, taken collectively, provide a reasonable additional basis for identifying those candidate ports suitable for the safe receipt and handling of foreign research reactor spent nuclear fuel.

D.1.1 Background

Since 1979, when the U.S. Nuclear Regulatory Commission (NRC) first began approving spent nuclear fuel shipments in the United States, 317 spent nuclear fuel shipments in Type B casks have been transported safely into several U.S. ports of entry. These include Newport News, Norfolk, and Portsmouth, VA; Portland, OR; Savannah, GA; and Oakland, CA (NRC, 1993). However, prior to the fall of 1993, DOE did not have any generally applicable criteria for identifying ports of entry. For this EIS, as well as for the Urgent Relief Environmental Assessment, DOE developed criteria to identify candidate ports of entry. The criteria used in this evaluation to identify potential ports for the receipt of foreign research reactor spent nuclear fuel are based on consideration of several independent factors, each described in more detail in the following sections.

D.1.2 Information on Past Spent Nuclear Fuel Shipments

The NRC has the authority under the Atomic Energy Act of 1954, as amended, to regulate certain aspects of spent nuclear fuel transportation. Of the thousands of shipments completed over the last 30 years in the United States and abroad, none has resulted in an injury due to the radioactive nature of the cargo (NRC, 1993). For the same period, about 1,200 (924 domestic and 293 foreign) overland shipments of spent nuclear fuel took place without any injury attributable to accidents or incident-free radiation doses during transport. Table D-1 provides the number of NRC and Department of Transportation regulated international and domestic overland shipments since 1979 (excluding DOE shipments). The casks that would be used in this program are robust Type B containers. The safety, safeguards, and precautions used for such shipments have historically been very successful (NRC, 1993).

Table D-1 Number of NRC/Department of Transportation Regulated Overland and International Spent Nuclear Fuel Shipments

Year	Overland		International[a]		
	Highway	Railway	Export	Import	Transient
1979	2	11	0	14	0
1980	73	5	2	55	0
1981	30	2	3	48	0
1982	80	0	1	43	0
1983	92	0	2	23	0
1984	209	3	2	34	0
1985	114	18	0	21	0
1986	88	15	0	17	0
1987	85	15	3	19	0
1988	10	7	0	15	0
1989	11	6	1	4	0
1990	0	8	2	0	3
1991	7	10	4	0	1
1992	17	6	0	0	0
Total	**818**	**106**	**20**	**293**	**4**

[a]*Ports included Newport News, Norfolk, and Portsmouth, VA; Savannah, GA; Portland, OR; and Oakland, CA.*

D.1.3 Federal Court Ruling

In the December 1991 decision of the U.S. District Court, District of Columbia Circuit, on the return of spent nuclear fuel from Taiwan, the court ruled that DOE must consider a reasonable range of alternative ports, including (at least) two low population density ports near DOE's Savannah River Site (U.S. District Court, 1991). In this appendix, DOE has identified a reasonable range of alternative ports on the East, Gulf, and West Coasts (including several low population ports) for the receipt, handling, and transhipment of foreign research reactor spent nuclear fuel to five potential DOE management sites (including the Savannah River Site) being considered in this EIS.

D.1.4 Notice of Intent Port Criteria

The Notice of Intent for this EIS (DOE, 1993) listed a series of preliminary criteria which might be applied to a potential list of candidate seaports to identify ports which would be acceptable for receipt, handling, and transhipment of foreign research reactor spent nuclear fuel. These proposed criteria included: "(a) adequacy of harbor and dock characteristics to satisfy the cask carrying ship requirements;

(b) availability of safe and secure lag storage; (c) adequacy of overland transportation systems from ports to the storage site(s); (d) experience in safe and secure handling of hazardous cargo; (e) emergency preparedness status at the port and nearby communities; and (f) proximity to the proposed storage sites." Either implicitly or explicitly, these criteria were considered in the port screening, as discussed in the following sections.

D.1.5 The U.S. Merchant Marine Academy Workshop Recommendations

A DOE-sponsored workshop on port selection criteria for spent nuclear fuel was held at the U.S. Merchant Marine Academy at Kings Point, New York, on November 15-16, 1993 (USMMA, 1994). Participants at the workshop included experts from the maritime industry in the areas of marine transportation, intermodal systems, marine insurance, admiralty law, U.S. Coast Guard Operations, U.S. Navy Operations, Military Sealift Command Operations, and national cargo, pilotage, and ships operations.

A series of panel discussions focused on issues such as economics and transportation safety, advantages of shipping spent nuclear fuel on various types of vessels, and shipping spent nuclear fuel through large versus small ports. The purpose of such discussions, in part, was to enable DOE to identify port criteria that would minimize both the actual and perceived risk involved in spent nuclear fuel shipments. The workshop participants agreed that any port capable of handling an ocean-going vessel is capable of receiving spent nuclear fuel. While some of these ports might have features that would make them more desirable than others (e.g., easy access from the open sea, modern facilities, etc.), no port would have such limitations as to preclude safe receipt of the spent nuclear fuel. While individual ports might not satisfy all the criteria recommended at the workshop, the workshop participants concluded that the criteria would provide a means of evaluating the relative merits of ports.

The three criteria recommended as necessary for safe shipment were: short distance from the open ocean to the port, adequate port cargo facilities, and intermodal access (i.e., for truck or rail shipments from the port to the management site).

A second set of recommendations that were listed as "important but not necessary" included: an experienced risk management staff, emergency preparedness and response capabilities, a skilled labor force aboard ship and in port, good port security, no local restrictions or regulations on movement of hazardous cargo, and no significant environmental considerations for the port.

Finally, the workshop also provided a list of "desirable" attributes for ports, including: distance of the port from a population center, proximity of the port to a spent nuclear fuel management location, "local economic issues" (e.g., areas that receive a significant fraction of their revenues from maritime and shipping activities), and personnel with training and experience in radioactive shipments and incident response.

D.1.6 Provisions of the National Defense Authorization Act for Fiscal Year 1994

On November 30, 1993, the National Defense Authorization Act for Fiscal Year 1994 was signed into law (NDAA, 1993). Section 3151 stipulates specific criteria that must be used "if economically feasible" and "to the maximum extent practicable" in selecting U.S. ports for both emergency and nonemergency receipt of foreign research reactor spent nuclear fuel at the Savannah River Site. Although the National Defense Authorization Act does not specifically address other potential DOE management sites, DOE assumed that the guidance provided for foreign research reactor spent nuclear fuel shipments to Savannah

River Site should be considered for the other four potential sites being considered in this EIS (Idaho National Engineering Laboratory, Hanford Site, Oak Ridge Reservation, and the Nevada Test Site), to the extent feasibility and practicability permitted.

Specifically, the National Defense Authorization Act requires that DOE may not receive foreign research reactor spent nuclear fuel if it "cannot be transferred in an expeditious manner from its port of entry in the United States to a storage facility that is located at a Department of Energy facility and is capable of receiving and storing the spent nuclear fuel." Further, it requires that the "Secretary of Energy shall, if economically feasible and to the maximum extent practicable, provide for the receipt of spent nuclear fuel....at a port of entry in the United States which...compared to each other port of entry....that is capable of receiving the spent nuclear fuel - (1) has the lowest human population in the area surrounding the port of entry; (2) is closest in proximity to the facility which will store the spent nuclear fuel; and (3) has the most appropriate facilities for, and experience in, receiving nuclear fuel (NDAA, 1993)."

D.1.7 Comments Received During the EIS Scoping Meetings and on the Urgent Relief Environmental Assessment

Nine public scoping meetings were held in November and December, 1993, at six cities being considered as potential ports for the receipt of spent nuclear fuel from foreign research reactors, and four cities near the potential spent nuclear fuel management sites discussed in this EIS. As a result of these meetings, DOE received several groups of similar comments, which have been incorporated into the development of the criteria (DOE, 1994a).

The largest number of comments (44) received on any general port-related issue dealt with avoiding ports in high population areas. Reasons ranged from concerns about accident consequences and possible terrorist attacks, to concerns about the ability to adequately respond to emergencies and possible evacuation of populations.

The second largest number of comments (32) suggested that alternative ports in low-population areas or ports operated by the military be seriously considered, and that ports that are closest to the storage sites and/or have the most direct transportation routes between the ports and management sites be considered.

Other comments that fall within the jurisdiction of DOE and within the scope of this EIS include: suggestions that selected ports should have experience handling spent nuclear fuel (9 comments); the safest marine terminals should be used at the port selected (3 comments); and that DOE should allow case-by-case designation of ports based on the most sensible options at the time each individual shipment occurs, considering the vessel, country of origin, time, cost, and overall experience of the ports (2 comments).

In addition to comments presented at the EIS Scoping Meetings, DOE has also considered individual comments and a list of suggestions from the Sierra Club on the draft Urgent Relief Environmental Assessment (DOE, 1994d).

D.1.8 Key Assumptions and Methodology for Port Identification

A number of possible maritime shipment modes are potentially available for shipping the foreign research reactor spent nuclear fuel over the next 10 or more years. The various transport modes generally determine which port facilities are adequate at each specific port [e.g., container cranes are required for container vessels, a pier for roll-on/roll-off vessels, and breakbulk cranes for breakbulk vessels]. While regularly scheduled cargo ships servicing commercial ports could be an important mode selected by owners of the foreign research reactor spent nuclear fuel for their shipments, smaller unscheduled vessels would also be a common mode of transport for multiple cask shipments (e.g., the first shipment of foreign research reactor spent nuclear fuel under the Urgent Relief Environmental Assessment in September 1994). This means that there will be a somewhat greater number of potential ports of entry to consider than if only larger, regularly scheduled commercial container vessels were to be used (details on potential vessel types that might be used are provided in Appendix C).

In addition to the types of vessels that could be used, the way foreign research reactor spent nuclear fuel casks are "packaged" for shipment is also a determinant in the selection of potential ports. For the Urgent Relief Environmental Assessment shipments to Savannah River Site, the Terms and Conditions for Financial Settlement for Receipt and Disposition of Foreign Research Reactor Spent Fuels (DOE, 1994c) required that spent nuclear fuel casks be containerized in 20 ft International Standards Organization containers (nominally, 2.4 m x 2.4 m x 6.1 m, or 8 ft x 8 ft x 20 ft), also called 20-ft equivalent units. Therefore, it was assumed that spent nuclear fuel casks would only be shipped containerized. This eliminates consideration of receipt and handling of foreign research reactor spent nuclear fuel casks in a "palletized" mode. Thus, the EIS focuses primarily on reasonable options for ports qualified for the receipt, handling, and transhipment of containerized spent nuclear fuel on any viable vessel type.

Among the ports that routinely handle containerized freight, two groups of ports - those along the in-land Mississippi River (above New Orleans) and those around the Great Lakes - are not considered in this evaluation. Access to these ports requires a long inland transit from open ocean. The U.S. Merchant Marine Academy recommendations discouraged such transits.

Finally, since the National Defense Authorization Act did not establish numerical distance or transport time limits for spent nuclear fuel transport, DOE concluded that, consistent with current and past Federal practice for transport of spent nuclear fuel in the contiguous United States, all overland shipments should be managed such that the spent nuclear fuel is kept moving as expeditiously as possible from the time it is placed on the transportation vehicle at the port of entry until it reaches the DOE management site, to the maximum extent practicable. For example, truck shipments (which typically involve two drivers in a tractor with a sleeping area) are assumed to be basically nonstop in order to deliver the spent nuclear fuel promptly, stopping only for fuel and food. This has been, and is expected to remain, DOE practice for such shipments.

NRC recently reported that for the period 1979-1992, rail transport only accounted for 8.6 percent of the total spent nuclear fuel shipments in the United States, but these shipments accounted for about 66 percent of the total quantity of spent nuclear fuel shipped (NRC, 1993). Rail travel (freight) typically takes much longer than truck transport when moving spent nuclear fuel on a dedicated railcar, where even short trips may require movement through additional intermodal terminals (e.g., transfer from rail to truck for site delivery), or intermediate points of dedicated railcar transfers to other train systems (e.g., from a local freight handler to one or more long distance freight lines). However, in the case of dedicated trains where entire multiple cask shipments (such as those used for the Urgent Relief shipment from the Military Ocean Terminal at Sunny Point (MOTSU) to the Savannah River Site) go directly from the port to the management site, rail travel times are expected to be somewhat longer than those for truck transport. Generally, rail distances are also typically somewhat longer than those for trucks using interstates, and rail transport generally costs more, and potentially exposes larger numbers of people since transits typically pass through major railyards in inner cities (see Appendix E for comparative travel distances for truck and rail).

In both cases, DOE concludes that by proper planning and compliance with current Department of Transportation and NRC shipment requirements (including use of pre-approved routes), each shipment of foreign research reactor spent nuclear fuel could be moved expeditiously from each port to each management site, and specific distance and time considerations do not serve to usefully discriminate against ports in the contiguous 48 States.

D.1.9 Methodology for Port Selection

The methodology for identifying acceptable ports of entry began with a list of 153 commercial ports throughout the contiguous United States. These ports included the 151 ports that were originally considered in the Urgent Relief Environmental Assessment (DOE, 1994d). The two additional commercial ports are Eddystone, PA, and Fernandina Beach, FL. Also, eight additional military ports in the contiguous United States suggested by the Military Traffic Management Command (MTMC, 1994a) were evaluated. The eight candidate military ports were those believed to routinely handle dry containerized cargoes (largely munitions), on breakbulk, container, and/or roll-on/roll-off vessels. Military ports are subject to extreme fluctuations in port activities as a function of national need. By using the criteria described below, ports that did not meet each DOE mandatory criterion in the sequence were eliminated. Those ports not eliminated at each step of the screening process were then evaluated in the same fashion against the remaining required criteria.

The required screening criteria DOE used to identify potential ports of entry are:

- The ports must have appropriate (routine) experience handling containerized cargo (Criterion 1);
- The ports must offer favorable transits from the open ocean to the selected terminals (Criterion 2);
- The ports must have appropriate facilities for safe receipt, handling, and transhipment of foreign research reactor spent nuclear fuel (Criterion 3);
- The ports must have ready access for intermodal transport (i.e., truck and rail facilities at or close to the selected terminal) (Criterion 4); and
- The human population of the ports and along transportation routes must be low to the extent economically feasible and maximum extent practicable (Criterion 5).

In selecting the final list of seaports from those found acceptable under Criterion 5, DOE applied several desirable port attributes. The potentially most useful of these ports for receipt, handling, and transhipment of foreign research reactor spent nuclear fuel to any of the five DOE management sites, and which also had the highest number of other desirable attributes, were selected for consideration and detailed analysis in the EIS.

D.1.9.1 Criterion 1: Appropriate Port Experience

The first criterion selected is one of the National Defense Authorization Act requirements for using ports with appropriate experience. The criterion is used first because if a port does not currently have appropriate container handling experience, or is unlikely to have this experience during the time period analyzed in this EIS, there is no reason to consider it further. For this screening, commercial ports that handle on the order of at least 20,000 20-ft equivalent units of containerized cargo per year [i.e., any mix of breakbulk, combination breakbulk/container ships, or self-contained ships that are equivalent to unloading (or loading) a small container vessel every week or two] were selected for further detailed analysis under the remaining criteria.

Because containerized spent nuclear fuel requires no special port experience or facilities specific to the handling of radioactive material, ports were not eliminated from consideration because of lack of such experience or facilities.

This criterion excludes experience in handling bulk liquid cargoes (e.g., oil or petrochemicals) or other bulk cargoes (e.g., grain, coal, etc.) unloaded using special cargo equipment not of the type used for receipt and handling of containerized foreign research reactor spent nuclear fuel shipments. It also excludes ports used primarily by fishing fleets or cruise ship liners.

Ports meeting the appropriate experience requirement would be those where port terminal(s) and operators routinely load and/or unload all types of containerized dry cargoes requiring the same type of handling as containerized spent nuclear fuel (e.g., everything from television sets and machine parts to toxic materials, flammable or explosive cargoes, etc.), or are likely to acquire such experience during the time period analyzed in this EIS (i.e., large cargo or container port expansions or improvements are planned within the next several years). DOE found that the status of commercial port facilities is very dynamic and subject to rapid and unpredictable changes. For example, the Port of San Francisco, CA lost four of its five major container lines to the Port of Oakland, CA early in 1994, and the Port of Morehead City, NC, has gone from on the order of 10,000 containers per year a few years ago to essentially no container service at the present time (DOE, 1994d). Similarly, the Port of Richmond, CA (while it still has two container cranes available and acceptable facilities) no longer receives significant numbers of containers (AAPA, 1994), although that could change in the near future.

This criterion also effectively eliminated ports that have infrequent container/breakbulk ship calls, marginal equipment or facilities, and were less likely to have well-trained and experienced personnel than busier ports during the period analyzed in this EIS (adequacy of ports and facilities for receiving, handling, and transhipping such cargoes will be addressed in Section D.1.9.3).

Out of the original list of 153 commercial candidate ports in the contiguous United States that were discussed earlier (excluding the 29 Great Lakes and upper Mississippi River ports), this screening resulted in the identification of 31 candidate seaports (see Table D-2 and Figure D-1). Many of the rejected ports were associated with oil or other bulk shipments, and were not viable for either breakbulk or container operations. These 31 commercial ports are considered to be reasonably representative of the total population of viable commercial seaports in the contiguous United States. Three of the eight military ports evaluated were found to generally satisfy this criterion, allowing for the cyclical nature of military activities at these ports (see Figures D-1 and D-2 and Table D-3). The acceptable military ports included the Military Ocean Terminal Bay Area in Oakland, CA, and the Naval Weapons Station (NWS) in Concord, CA, as potential West Coast ports of entry, and MOTSU for a potential East Coast port of entry. This criterion screened out all naval bases and shipyards in the contiguous United States because they do not regularly handle containerized cargo from ocean-going vessels in any significant quantity.

There is great uncertainty associated with attempts to project the future of port activities and possible availability for receipt, handling, and transhipment of foreign research reactor spent nuclear fuel. Many of the features and facilities of ports addressed in Criterion 3 are inextricably related to the likelihood that any given port will meet the minimum requirements for "appropriate" experience in the future. Thus, for example, if a specific port lacks adequate facilities and equipment at present, and there is no identifiable intention of improving the port in the future, it is unlikely that the port will develop the appropriate

Table D-2 Commercial Ports with Appropriate Experience Receiving, Handling, and Transhipping Containerized Dry Cargoes[a]

U.S. Seaport	Appropriate Experience	U.S. Seaport	Appropriate Experience	U.S. Seaport	Appropriate Experience
Alameda, CA	No	Gloucester City, NJ	No	Port Angeles, WA	No
Albany, NY	No	Gramercy, LA	No	Port Arthur, TX	No
Alexandria, VA	No	Grays Harbor, WA[c]	No	Port Canaveral, FL	No
Anacortes, WA	No	Green Bay, WI	NA	Port Costa, CA	No
Antioch, CA	No	Gulfport, MS	Yes	Port Everglades, FL	Yes
Ashtabula, OH	NA	Hopewell, VA	No	Port Hueneme, CA	No
Astoria, OR	No	Houston, TX	Yes	Port Manatee, FL[c]	No
Baltimore, MD	Yes	Huntington Beach, CA	No	Port Neches, TX	No
Baton Rouge, LA	NA	Huron, OH	NA	Port Royal, SC	No
Bay City, MI	NA	Jacksonville, FL	Yes	Port San Luis, CA	No
Beaumont, TX[c]	No	Kalama, OR	No	Port Sulfur, LA	No
Bellingham, WA	No	Kenosha, WI	NA	Port St. Joe, FL	No
Benicia, CA	No	La Place, LA	No	Port Townsend, WA	No
Boston, MA	Yes	Lake Charles, LA	Yes	Portland, OR	Yes
Bridgeport, CT	No	Long Beach, CA	Yes	Portland, ME[c]	No
Brownsville, TX	No	Longview, WA[c]	No	Portsmouth, NH[c]	No
Brunswick, GA	No	Lorain, OH	NA	Portsmouth, VA	Yes
Buffalo, NY	NA	Los Angeles, CA	Yes	Providence, RI	No
Burns Harbor, IN	NA	Mandalay Beach, CA	No	Raymond, WA	No
Cambridge, MD	No	Manitowoc, WI	NA	Redwood City, CA	No
Camden, NJ[c]	No	Marcus Hook, PA	No	Reedsport, OR	No
Carlsbad, CA	No	Marine City, MI	NA	Reserve, LA	No
Carpinteria, CA	No	Miami, FL	Yes	Richmond, VA	Yes
Charleston, SC	Yes	Milwaukee, WI	NA	Richmond, CA[c]	No
Chicago, IL	NA	Mobile, AL[c]	No	Rochester, NY	NA
Cleveland, OH	NA	Morehead City, NC	No	Sacramento, CA	No
Conneaut, OH	NA	Moss Beach, CA	No	Saginaw, MI	NA
Coos Bay, OR	No	Muskegon, MI	NA	San Diego, CA[c]	No
Corpus Christi, TX[c]	No	New Bedford, MA	No	San Francisco, CA	Yes
Crescent City, CA	No	New Haven, CT	No	Sandusky, OH	NA
Crockett, CA	No	New London, CT	No	Savannah, GA	Yes
Delaware City, DE	No	New Orleans, LA	Yes	Searsport, ME	No
Detroit, MI	NA	New York, NY[b]	Yes	Seattle, WA	Yes
Duluth, MN	NA	Newport News, VA	Yes	Sheboygan, WI	NA
Eddystone, PA	Yes	Newport, OR	No	Stockton, CA	No
Edmonds, WA	No	Norfolk, VA	Yes	Superior, WI	NA
El Segundo, CA	No	Oakland,CA	Yes	Tacoma, WA	Yes
Erie, PA	NA	Ogdensburg, NY	NA	Taft, LA	No
Essexville, MI	NA	Olympia, WA	No	Tampa, FL[c]	No
Estero Point, CA	No	Orange, TX	No	Texas City, TX	No
Eureka, CA	No	Ostrica, LA	No	Toledo, OH	NA
Everett, WA	No	Oswego, NY	NA	Uncle Sam, LA	No
Fairport Harbor, OH	NA	Palm Beach, FL	Yes	Vallejo, CA	No
Fall River, MA	No	Panama City, FL	No	Vancouver, WA[c]	No
Ferndale, WA	No	Pascagoula, MS	No	Venice, LA	No
Fernandina Beach, FL	Yes	Paulsboro, NJ	No	Ventura, CA	No
Freeport, TX	Yes	Pensacola, FL	No	Willapa Bay, WA	No
Friday Harbor, WA	No	Philadelphia, PA	Yes	Wilmington, DE	Yes
Galveston, TX	Yes	Pilottown, LA	No	Wilmington, NC	Yes
Gaviota, CA	No	Pittsburgh, CA	No	Winslow, WA	No
Georgetown, SC	No	Point Wells, WA	No (Closing)		

[a] *For possible use by breakbulk, container, Roll-on/Roll-off or combination vessels. No Great Lakes ports or ports far up the Mississippi River were evaluated in detail because of the unacceptably long transits on crowded inland waterways or need for additional intermodal transfers (listed as "not applicable" or NA).*

[b] *Includes the preferred terminal at Elizabeth, NJ.*

[c] *Does have limited dry cargo facility; could acquire appropriate experience during 10 to 15-years.*

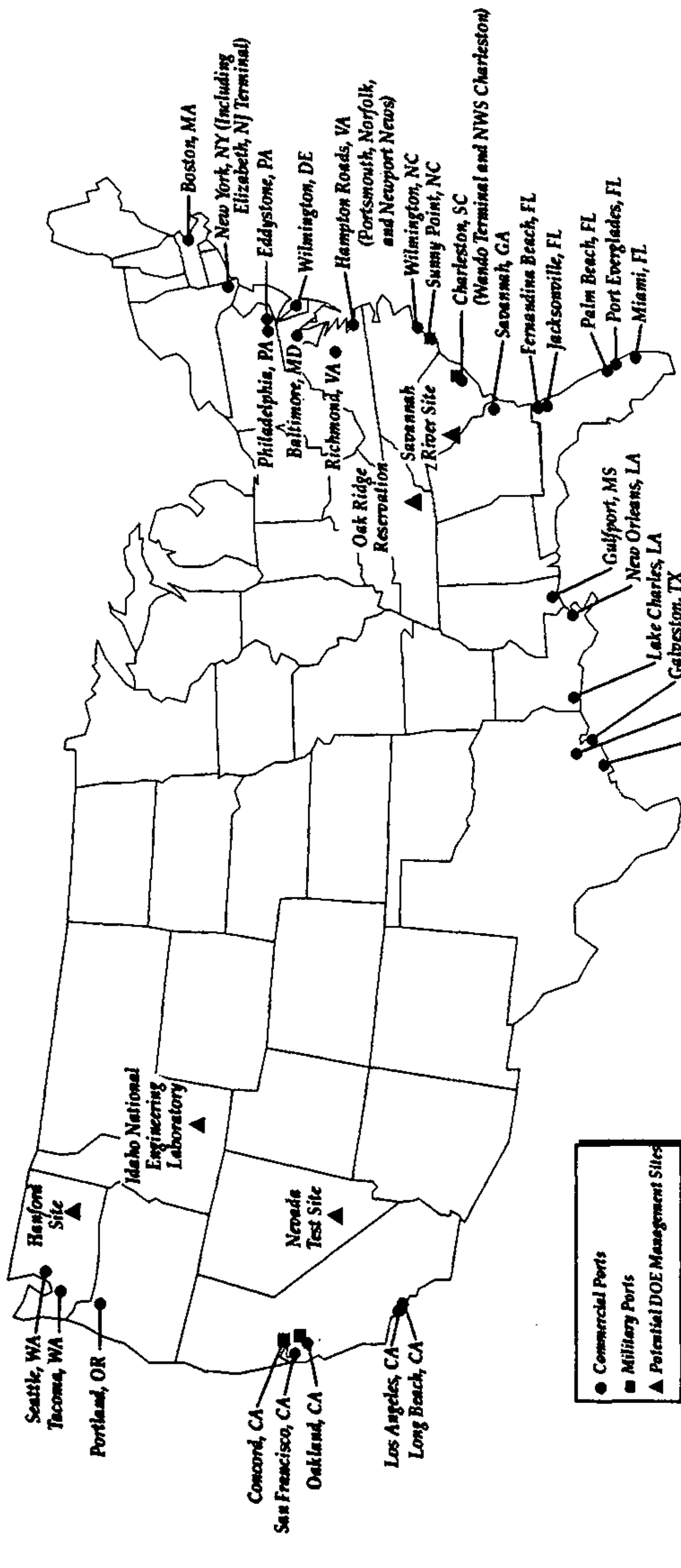


Figure D-1 Locations of Candidate Ports of Entry and DOE Management Sites

❶ *Appropriate Port Experience:*

- Ports routinely handle containerized cargo (at least 20,000 TEUs/yr)

a. *Accepted 31 Commercial Ports:*

Baltimore, MD*
Boston, MA
Charleston, SC
Eddystone, PA*
Elizabeth, NJ
Fernandina Beach, FL
Freeport, TX
Galveston, TX
Gulfport, MS
Houston, TX
Jacksonville, FL
Lake Charles, LA
Long Beach, CA
Los Angeles, CA
Miami, FL
Newport News, VA*
New Orleans, LA
Norfolk, VA*
Oakland, CA*
Palm Beach, FL
Philadelphia, PA
Port Everglades, FL
Portland, OR*
Portsmouth, VA*
Richmond, VA
San Francisco, CA
Savannah, GA*
Seattle, WA
Tacoma, WA
Wilmington, DE
Wilmington, NC

b. *Accepted 3 Military Ports**:*

Military Ocean Terminal
Sunny Point, NC*

Military Ocean Terminal
Oakland, CA

Naval Weapons Station
Concord, CA

** Database indicates Port has handled SNF or other Type B cask shipments*

*** Military ports meet 20,000 TEU requirement on a periodic basis, but cycle between high and low work loads based on military demands*

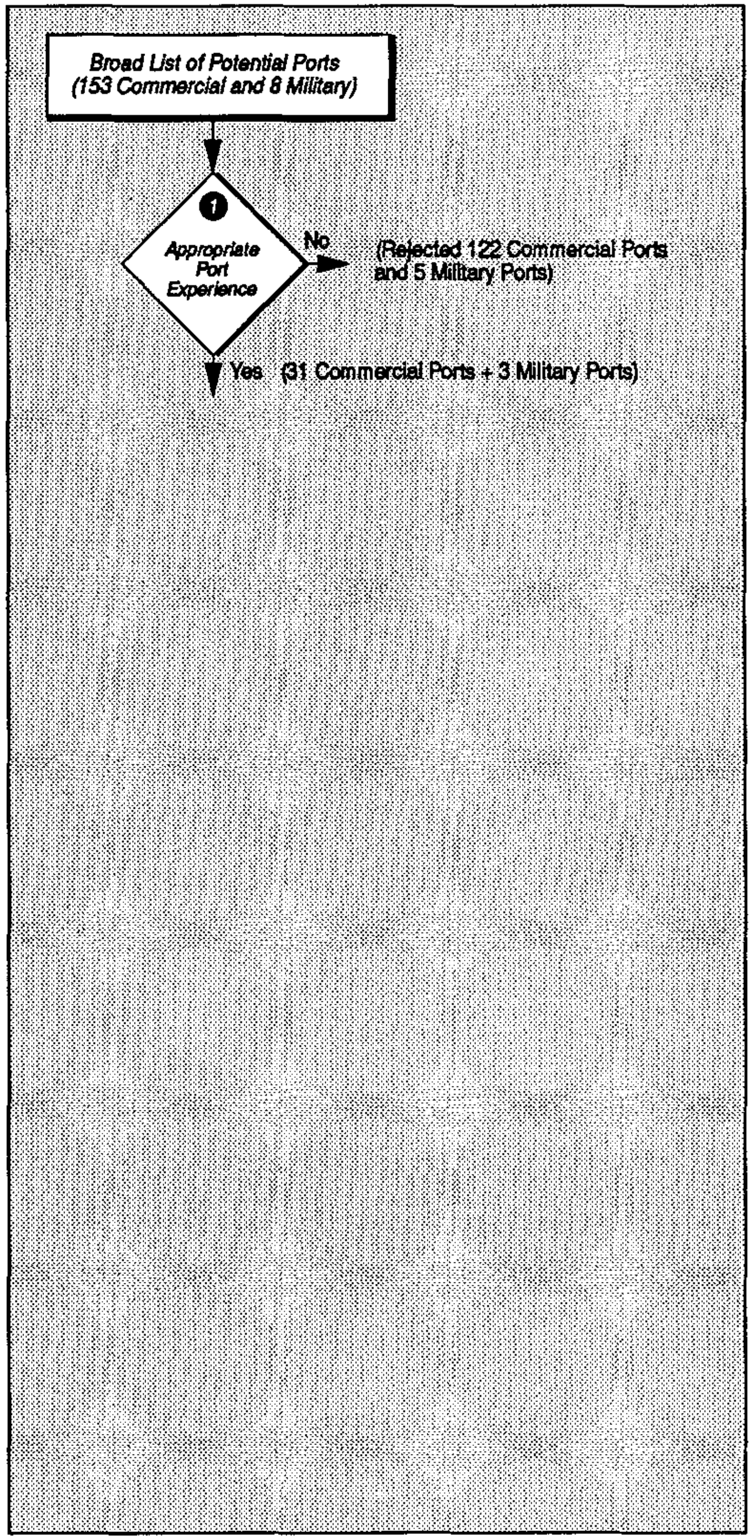


Figure D-2 Screening Ports with Appropriate Experience Criterion

Table D-3 Military Ports with Appropriate Experience Receiving, Handling, and Transhipping Containerized Dry Cargoes

U.S. Military Port	Appropriate Experience[a]
Bayonne, NJ (Military Ocean Terminal)	No
Cheatham Annex, VA (Navy)	No
Concord, CA (Naval Weapons Station)	Yes
Kings Bay, GA (Submarine Base)	No
Oakland, CA (Military Ocean Terminal)	Yes
Port Hueneme, CA (Naval Construction Battalion Center)	No
Sunny Point, NC (Military Ocean Terminal, MOTSU)	Yes
Yorktown, VA (Naval Weapons Station)	No

[a]*Military ports meet 20,000 twenty-foot equivalent units/yr requirement on a periodic basis and retain a corp of experienced port workers.*

Sources of information include: MTMCTEA, 1992 (Bayonne, NJ); MTMC, 1994a (Cheatham Annex, VA); Yocum, 1994a and 1994b (Concord, CA); FHI, 1993b (Kings Bay, GA); MTMC, 1994b; MTMCTEA, 1990 (Port Hueneme, CA); DOE, 1994d (Sunny Point, NC); and FHI, 1994a (Yorktown, VA).

experience required during the period analyzed in this EIS. As a result, DOE searched the available literature and scanned port-specific information from a number of sources (including direct discussions with numerous port officials) to identify planned future port improvements to see if that information could be used to tentatively increase the number of potential ports in subsequent port screenings for other necessary criteria. The results of this review are addressed further in Attachment D1 to this appendix. The basic finding was that all identifiable future port improvements were generally being made in ports that already meet the appropriate experience criterion (also see Attachment D1 to this appendix for projected port improvements that have been identified). As a result, that test for potential future port utilization did not yield any additional ports for subsequent screening.

On the other hand, DOE also found that some ports already have adequate facilities, but for one reason or another have been unable to attract enough container shipments to ensure a reasonable core of experienced workers (e.g., Port of Richmond, CA). In such cases, future projections are extremely uncertain, since there is no way of knowing whether ports will be successful in marketing new business opportunities in the future. As a result, DOE concluded that there was no useful purpose served in keeping these ports in the list for subsequent screening.

D.1.9.2 Criterion 2: Favorable Transit From Open Ocean

This criterion was based on recommendations from the U.S. Merchant Marine Academy Workshop participants who found that a short transit from the open ocean to port was necessary to maximize the safety of shipments of spent nuclear fuel (USMMA, 1994). However, it is clear that since this criterion focuses on ship safety, it is essentially synonymous with the requirement for a favorable ship transit from the open ocean to the port. Thus, while a port might be within a few miles of the open sea, if there were numerous hard shoals, ship wrecks, or reefs along the ship channel, this port might be less desirable than other ports with longer but less risky transits. On the other hand, ports that can only be reached by transporting spent nuclear fuel through long, narrow, winding, or crowded ship channels present additional risks that can be avoided by using ports that are easier to reach.

As a result, DOE concluded that ports meeting the intent of this criterion would have relatively short trips to port from large, deep bodies of water that were either oceans, seas, or notable extensions thereof, such as large bays or sounds (e.g., Chesapeake Bay, San Francisco Bay, or Puget Sound), and which present no special navigational hazards to ships (including adequate width and depth of water in ship channels). A minimum channel depth (mean low water) of 7.6 m (25 ft) was selected to permit use by at least small to intermediate size vessels.

Less desirable were potential ports that could only be reached by traversing long, narrow and/or winding, or crowded ship channels [e.g., the St. Lawrence seaway to a Great Lakes port or the long passage up the Galveston/Houston ship channel to Houston (which is crowded by oil tankers in the channel and numerous petroleum and petrochemical plants along the channel that could impact on ship safety in the event of a plant or pipeline accident)].

Reliable data on risks associated with transits are difficult to find. In 1991, the U.S. Coast Guard established a national database on ship accidents. The 46 Code of Federal Regulations (CFR) §4.05-1 defines reportable accidents as those events that (1) leave a vessel damaged and presenting a navigational hazard (e.g., loss of propulsion or steering) or affect seaworthiness, (2) cause damage in excess of $25,000, or (3) result in serious injury or loss of life. Included in the database are allisions (single ship collisions with fixed structures such as buoys, docks, or bridges), collisions (between two vessels while under power), hard groundings (where a vessel cannot free itself), and fires onboard cargo vessels due to other accidents (USCG, 1994a and 1994b). However, since these accident statistics are not comprehensive and include barge accidents in addition to those involving ocean-going vessels, it is difficult to provide sound and reliable estimates of accident frequencies and types per transit to port.

Using all of the information currently available that pertains to analysis of this criterion, DOE found that the Ports of Richmond VA, New Orleans and Lake Charles, LA, and Houston, TX do not meet the criteria for receipt of foreign research reactor spent nuclear fuel at this time.

As shown in Table D-4 and Figure D-3, application of this criterion resulted in the retention of 27 commercial seaports and three military ports for further analysis.

D.1.9.3 Criterion 3: Appropriate Port Facilities

The National Defense Authorization Act requires the use of ports with "appropriate port facilities" that allow safe handling of foreign research reactor spent nuclear fuel. The U.S. Merchant Marine Academy Workshop recommended as "necessary for safe shipment" that an acceptable port have "adequate port cargo facilities," which included (1) berthing options (e.g., so that conflicting activities at an adjacent berth or onshore could be avoided if necessary), and (2) onsite cranes with trained operators (while it was recognized that ports without cranes could use other means to offload a vessel, the panel preferred ports with cranes).

Thus, port facilities must possess the following minimum physical attributes: (1) adequate water depths alongside piers [at least 7.6 m (25 ft) was selected for this screening] for docking at least small to intermediate-sized vessels, (2) adequate wharfs and quays, with berthing options (in case a potential for conflicting operations exists near the berth of choice), for securing vessels and safely offloading, and carrying the necessary spent nuclear fuel loads, and (3) at least one adequate crane for offloading containerized spent nuclear fuel onto ground transport [at least a 30 metric ton (33 ton) capacity crane was selected for this screening].

While many small ports have cranes with large lift capacities [100 metric tons (110 tons) or more], they are not purpose-built container cranes and must use special container spreaders for use with containers. Although the U.S. Merchant Marine Academy Workshop found it "desirable" for a port to have an adequate purpose-built container crane available, participants determined it was unnecessary to have one.

Table D-4 Required Maritime Transit Criterion for Selection of Seaports for Foreign Research Reactor Spent Nuclear Fuel Shipments

Seaports	Distance from Open Sea (km)[a]	Favorable Transit
Commercial		
Baltimore, MD	240	Yes
Boston, MA	12	Yes
Charleston, SC	11	Yes
Eddystone, PA	120	Yes
Elizabeth, NJ	18	Yes
Fernandina Beach, FL	15	Yes
Freeport, TX	6	Yes
Galveston, TX	16	Yes
Gulfport, MS	30	Yes
Houston, TX	71	No
Jacksonville, FL	11	Yes
Lake Charles, LA	52	No
Long Beach, CA	4	Yes
Los Angeles, CA	5	Yes
Miami, FL	5	Yes
Newport News, VA	40	Yes
New Orleans, LA	160	No
Norfolk, VA	35	Yes
Oakland, CA	15	Yes
Palm Beach, FL	6	Yes
Philadelphia, PA	130	Yes
Port Everglades, FL	2	Yes
Portland, OR	140	Yes
Portsmouth, VA	40	Yes
Richmond, VA	190	No
San Francisco, CA	19	Yes
Savannah, GA	24	Yes
Seattle, WA	5	Yes
Tacoma, WA	5	Yes
Wilmington, DE	100	Yes
Wilmington, NC	38	Yes
Military		
NWS Concord, CA	60	Yes
MOTBA, CA	15	Yes
MOTSU, NC	16	Yes

[a] *To convert distance to miles, divide by 1.6.*

Thus, while it is preferable to avoid any additional risks associated with the use of general purpose cranes (even though small) by using terminals with equipment designed to handle containerized cargo (an alternative to port container cranes might be the use of combination breakbulk/container vessels with shipboard container cranes that are generally operated by trained and experienced port stevedores), a purpose-built container crane was not determined to be necessary to satisfy this criterion. Military ports also represent a special case, since most do not have such purpose-built container cranes, and use a container spreader attachment when necessary.

❷ *Favorable Transit to Port:*

- Port within reasonable distance from the open sea, with favorable transit

a. *Accepted 27 Commercial Ports:*

Baltimore, MD
Boston, MA
Charleston, SC
Eddystone, PA
Elizabeth, NJ
Fernandina Beach, FL
Freeport, TX
Galveston, TX
Gulfport, MS
Jacksonville, FL
Long Beach, CA
Los Angeles, CA
Miami, FL
Newport News, VA
Norfolk, VA
Oakland, CA
Palm Beach, FL
Philadelphia, PA
Port Everglades, FL
Portland, OR
Portsmouth, VA
San Francisco, CA
Savannah, GA
Seattle, WA
Tacoma, WA
Wilmington, DE
Wilmington, NC

b. *Accepted 3 Military Ports:*

Military Ocean Terminal
Sunny Point, NC

Military Ocean Terminal
Oakland, CA

Naval Weapons Station
Concord, CA

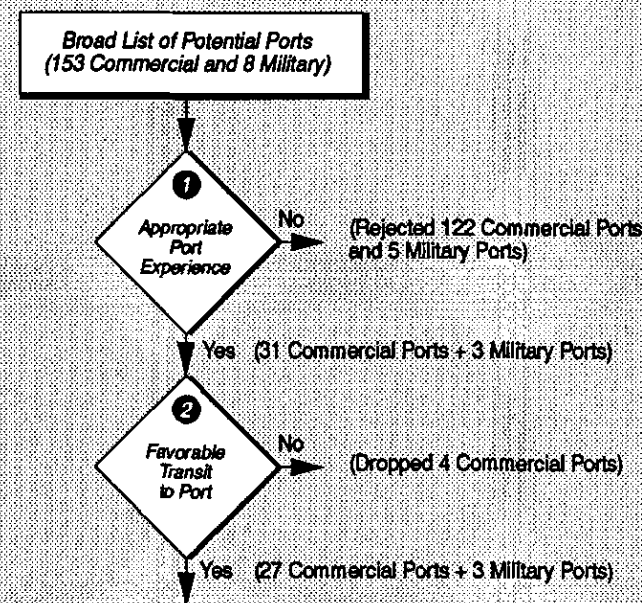


Figure D-3 Screening Ports for Favorable Transit Criterion from Sea to Port

Because containerized spent nuclear fuel requires no special port experience or facilities specific to the handling of radioactive material, ports were not eliminated from consideration because of lack of such experience or facilities.

As noted earlier, there is no reasonable way of determining the future likelihood that currently marginal ports that already have adequate facilities (but simply lack "appropriate experience") will acquire such experience. It depends totally on whether the ports will be able to induce shipping lines to use their facilities. In the area of appropriate facilities, however, there is much less uncertainty in making such determinations, since the planning process for port improvements must be made years in advance in order to allow time for land acquisition, funding, and other approvals before such improvements can be made. Therefore, those ports that have current plans for improvements that might permit their consideration for purposes of this EIS are much easier to identify. As a result, available information relating to future port improvements was studied carefully. Ports with substantial identified improvements or developments during the period analyzed in this EIS include: Baltimore, MD; Boston, MA; Charleston, SC; Fernandina Beach, FL; Gulfport, MS; Jacksonville, FL; San Francisco, CA; Oakland, CA; Long Beach, CA; Naval Weapons Station Concord, CA; Los Angeles, CA; Miami, FL; Mobile, AL; New Orleans, LA; Norfolk, VA; Philadelphia, PA; Port Everglades, FL; New York, NY; Portland, OR; Savannah, GA; Seattle and Tacoma, WA; and Wilmington, DE. Details on these improvements are shown in Attachment D1 to this appendix. All of these ports (except Mobile, AL) currently have both adequate experience and facilities without further improvements. Therefore, no additional ports were identified for foreign research reactor spent nuclear fuel receipt in the future. (Mobile, AL will meet the requirement for experience if it approximately doubles its current container business in the future, but that is too speculative to be useful at this time).

In addition to physical attributes of port facilities, public safety also depends on the reliability of the personnel operating the facilities. In addition to port accidents related to a failure of the container-handling equipment, human error can also increase risks of accidents. The U.S. Merchant Marine Academy Workshop identified the skill of the labor force at a port as an important (but not mandatory) criterion.

While the U.S. Merchant Marine Academy Workshop preferred ports with cranes, it also considered the use of roll-on/roll-off vessels, but preferred the use of other vessels for a number of reasons. Although roll-on/roll-off is not as likely to be used for spent nuclear fuel shipments as conventional cargo vessels due to costs, availability, and other factors, such vessels require only adequate water depths and appropriate piers to receive foreign research reactor spent nuclear fuel. As a result, the presence of roll-on/roll-off facilities is noted in Section D.2 in the detailed discussions of potential ports, but was not considered an adequate sole basis for port selection.

Several related "desirable" attributes for port facilities were recommended by the U.S. Merchant Marine Academy Workshop or identified during the port analyses. These attributes which would contribute to a port having "appropriate facilities," but were not required for safe receipt, handling, and transhipment of spent nuclear fuel include: (1) secure short-term storage areas (in the event of unexpected events such as snow or icing of roads), (2) the existence of emergency planning and training, (3) the absence of environmentally sensitive areas in port or local restrictions on movement of spent nuclear fuel, (4) the absence of conflicting uses (e.g., explosives, petroleum, tourism), and (5) minimal likelihood of severe natural phenomena impacting port activities (such as high winds from hurricanes, floods, earthquakes, volcanoes). These desirable port attributes are used in final port selection in Section D.1.8.5, and are discussed for each port in Section D.2.

In applying the DOE criteria, it became evident that the majority of the ports that met the first required screening criterion (Appropriate Port Experience) also met these requirements. Application of the Appropriate Facility Criterion retained 25 commercial ports and three military seaports for further analysis. Two commercial ports, Freeport, TX and Palm Beach, FL were dropped due to the application of this criterion. The results of this screening are summarized in Figure D-4.

D.1.9.4 Criterion 4: Ready Access to Intermodal Transportation

A U.S. Merchant Marine Academy Workshop criterion determined to be necessary for safe shipment of spent nuclear fuel was "intermodal access", which means "ready access from a port" to truck and rail routes. It is becoming common practice for ports with intermodal transfer facilities to carry off-loaded containers on special port-owned container handling equipment to a marshalling yard adjacent the terminal, where the containers are loaded onto trucks or rail for shipment to the consignee. Such transfers tend to minimize traffic congestion at shipside by using experienced port personnel and specialized port equipment. These intermodal transfers are increasingly accomplished with purpose-built container handling equipment (straddle carriers, sidelifts, front-end loaders, stackers, and container forklifts) that require no additional workmen for container handling. Given that the handling is done very rapidly and securely by a single operator, the opportunities for additional worker exposures or serious accidents are minimized. Moving a container from a pier to a marshalling area a few kilometers more distant than one at a terminal has little significance with regard to either worker exposure or public risk (see, for example, container handling equipment in Jane's, 1992).

DOE found that most of the potential ports accepted under the three preceding required criteria also had good access to interstate highways and rail transport. However, smaller ports and most military ports with more limited facilities could also accept containerized spent nuclear fuel from combination breakbulk/container vessels or roll-on/roll-off vessels. These ports often have limited intermodal capabilities for rail in the immediate vicinity of a pier, but the spent nuclear fuel could be trucked to a rail area (often a few miles or less) for loading on a railcar. While these arrangements could involve an additional intermodal transfer, such transfers are typically also done rapidly using special container handling equipment. Therefore, they do not involve significant additional opportunities for worker exposure or accidents than would be the case for movement of foreign research reactor spent nuclear fuel from a pier to an intermodal yard at a large port.

DOE concluded that the lack of an intermodal rail facility immediately at a terminal should not eliminate an otherwise desirable port from further evaluation, if rail access was reasonably close to the port (e.g., container cargo from the Wando Terminal in Charleston, SC, must be trucked a few miles to an intermodal facility in North Charleston for transfer to rail). All ports evaluated have acceptable intermodal access for trucks, although smaller ports typically do not have dedicated truck routes for access to interstates, and may require short transports through sometimes congested local traffic to reach the interstate highway system. This apparent conflict between requirements for ready intermodal access at ports and the National Defense Authorization Act requirement for using ports with the "lowest human populations" has been balanced to permit some small ports with more limited intermodal capabilities to be considered for further screening, since the additional public impacts associated with a few miles' transport through urban populations would be small compared to public impacts associated with transport over hundreds or thousands of miles of the country's Interstate highway system.

Application of the intermodal access criterion resulted in acceptance of 25 commercial seaports and three military ports (i.e., no additional ports were rejected) for further analysis using the remaining DOE criteria. The results of applying this criterion to commercial and military ports are shown in Figure D-5. Details regarding intermodal access are addressed in each port description in Section D.2.

❸ *Appropriate Facilities:*

- Adequate crane(s), piers, depth of water alongside, etc.

a. Accepted 25 Commercial Ports:

Baltimore, MD
Boston, MA
Charleston, SC
Eddystone, PA
Elizabeth, NJ
Fernandina Beach, FL
Galveston, TX
Gulfport, MS
Jacksonville, FL
Long Beach, CA
Los Angeles, CA
Miami, FL
Newport News, VA
Norfolk, VA
Oakland, CA
Philadelphia, PA
Port Everglades, FL
Portland, OR
Portsmouth, VA
San Francisco, CA
Savannah, GA
Seattle, WA
Tacoma, WA
Wilmington, DE
Wilmington, NC

b. Accepted 3 Military Ports:

Military Ocean Terminal
Sunny Point, NC

Military Ocean Terminal
Oakland, CA

Naval Weapons Station
Concord, CA

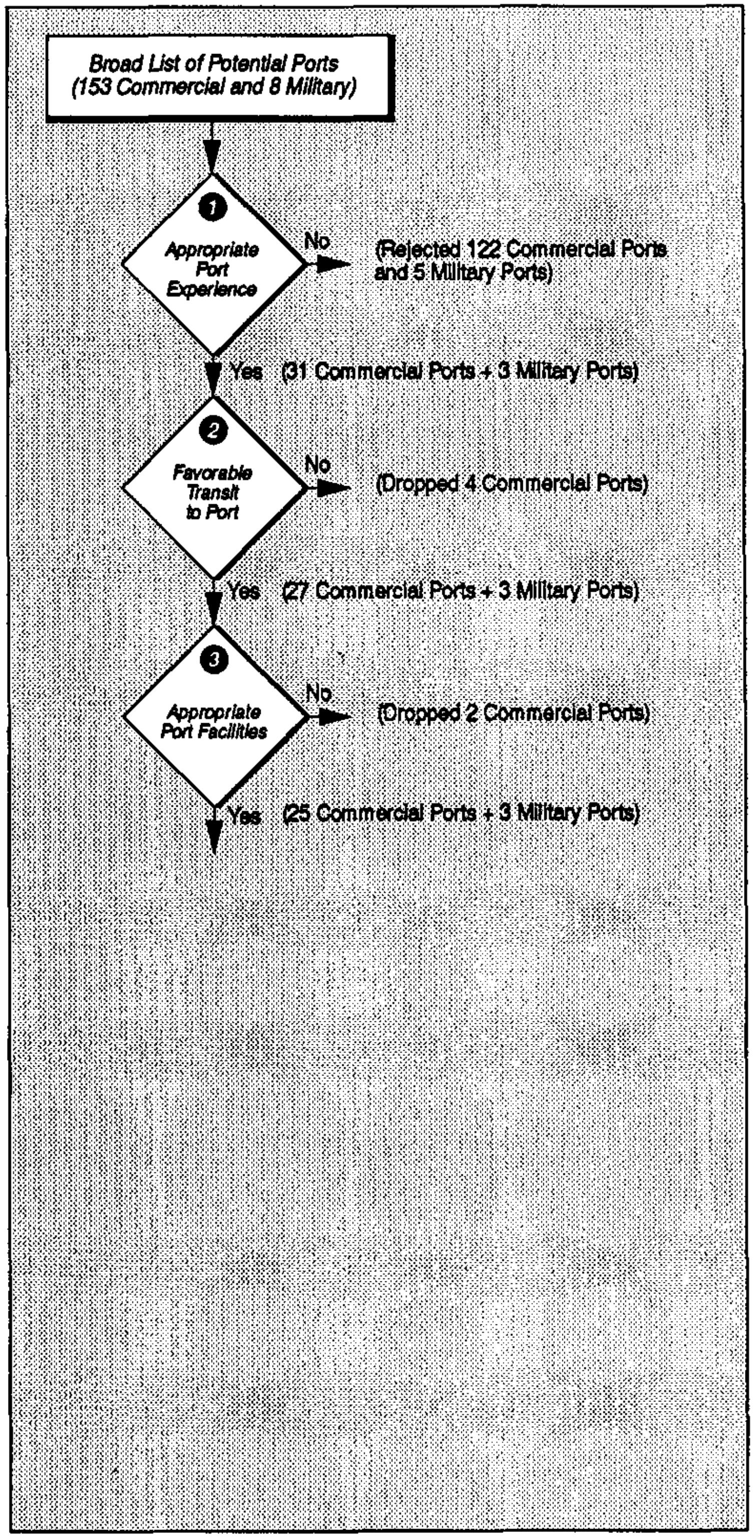


Figure D-4 Screening Ports with Appropriate Facilities Criterion

4 Intermodal Access:

a. *Accepted 25 Commercial Ports (SRS and ORNL unless otherwise specified):*

Baltimore, MD
Boston, MA
Charleston, SC
Eddystone, PA
Elizabeth, NJ
Fernandina Beach, FL
Galveston, TX
Gulfport, MS
Jacksonville, FL
Long Beach, CA
Los Angeles, CA
Miami, FL
Newport News, VA
Norfolk, VA
Oakland, CA
Philadelphia, PA
Port Everglades, FL
Portland, OR
Portsmouth, VA
San Francisco, CA
Savannah, GA
Seattle, WA
Tacoma, WA
Wilmington, DE
Wilmington, NC

b. *Accepted 3 Military Ports:*

Military Ocean Terminal
Sunny Point, NC

Military Ocean Terminal
Oakland, CA

Naval Weapons Station
Concord, CA

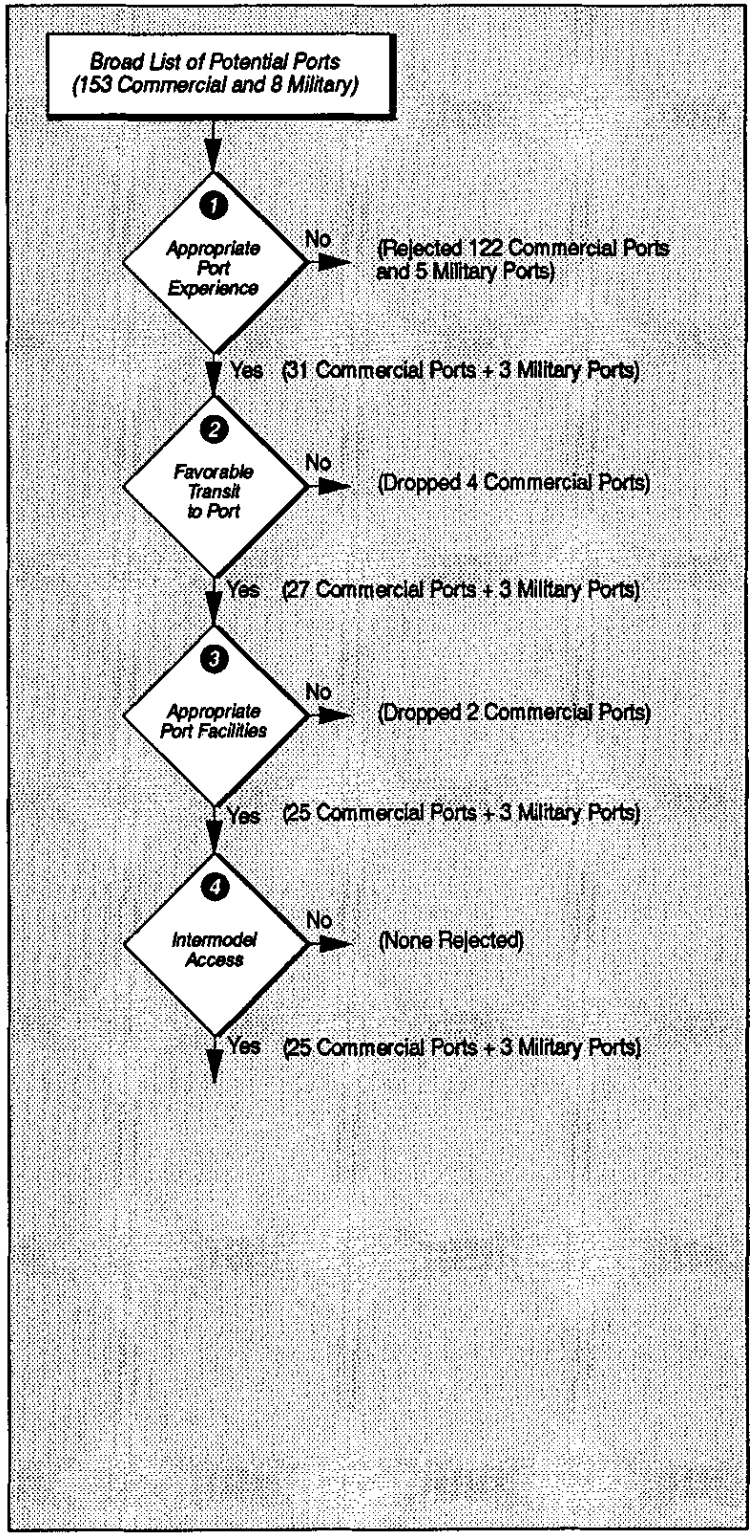


Figure D-5 Screening Ports for Ready Access to Intermodal Transportation

D.1.9.5 Criterion 5: Human Populations

While only dealing with foreign research reactor spent nuclear fuel shipments bound for the Savannah River Site, the Federal court ruling discussed in Section D.1.3 indicates that the courts consider port populations to be an important ingredient in the National Environmental Policy Act (NEPA) process for assessing the range of reasonable port alternatives.

NEPA requires that DOE consider a range of reasonable alternatives for potential ports of entry. On the other hand, the National Defense Authorization Act port selection factors required that, if economically feasible and to the maximum extent practicable, ports of entry for foreign research reactor spent nuclear fuel bound for the Savannah River Site have the lowest human populations in the area surrounding the port. While the National Defense Authorization Act was written specifically to regulate the receipt and storage of foreign research reactor spent nuclear fuel at the DOE's Savannah River Site, DOE elected to apply this criterion in identifying ports of entry for all five potential sites, to the maximum extent practicable.

DOE has considered a number of potential definitions of "lowest human populations" and resulting models that might be used to satisfy the National Defense Authorization Act lowest population factor (NDAA, 1993). These include using the same approach used in the Urgent Relief Environmental Assessment (DOE, 1994d), and variations that might be useful for identifying ports for inclusion in this EIS. A description of the various approaches that were considered are provided in Attachment D3 to this appendix.

As shown in the Urgent Relief Environmental Assessment (DOE, 1994d) and this EIS (Chapter 4), public risk is driven not only by port populations, but by the populations within the immediate proximity of truck and rail shipments from each port to each management site. For each selected port and each selected mode of overland transport (truck or rail), the total "affected" population represents a unique population surrounding the port plus those along the transport route to each of the five potential DOE management sites. DOE considered the affected populations outside the immediate port vicinity along the routes to the management sites to be as important for protection of public health and safety as those within the vicinity of the port terminals, for both incident-free transport and a range of potential accidents.

DOE evaluated port populations within the radii of three distances: 1.6 kilometers (km) [1 mile (mi)], 8.0 km (5 mi), and 16 km (10 mi). These populations are shown in Table D-5. DOE expects that the 1.6 km (1 mi) radius population would include resident members of the public immediately outside the port who would be the most likely to be affected by severe accidents and incident-free impacts. In addition, the radioactivity, which is hypothesized to be released from a very severe accident (long-term fire leading to severe cask damage), would be lofted high into the air and would not normally produce peak ground-level air concentrations until well outside the 1.6 km (1 mi) radius. Therefore, the 1.6 km (1 mi) population was not considered adequate to reflect the population criterion.

The population within a 16 km (10 mi) radius was selected to be consistent with the results of analyses of severe hypothetical accidents described in Section D.5 of this appendix. For severe accidents in ports, the maximum radiation dose to an individual located 16 km (10 mi) from the port is typically much lower than the dose to the maximally exposed individual. However, analyses of the potential impacts of severe accidents in a range of port populations show that the average dose to members of the public within a 16 km (10 mi) radius of the port is higher than the average per capita dose for any of the larger radii around the port for typical (i.e., 50th percentile) meteorology and typical dry deposition and fallout patterns. Further, as discussed in section D.5.4, most of the population dose for even severe accidents occurs within the 16 km (10 mi) radius. Less energetic accident scenarios would cause less dispersion and

Table D-5 Total Populations within Three Distances of Selected U.S. Ports

Name of the Port	Within 1.6 km (1 mi)	Within 8 km (5 mi)	Within 16 km (10 mi)
NWS Concord, CA	14	71,152	381,070
MOTSU, NC	21	960	7,995
Tacoma, WA	94	172,124	511,575
Portland, OR	280	69,039	356,064
Elizabeth, NJ	378	596,076	3,223,038
MOTBA, CA	419	312,133	1,288,699
Jacksonville, FL	523	72,313	334,212
Seattle, WA	557	270,145	753,296
Wilmington, DE	753	166,165	381,502
Gulfport, MS	761	50,218	113,153
Baltimore, MD	818	352,730	1,182,024
Savannah, GA	860	30,845	155,166
Long Beach, CA	1,025	270,336	1,014,418
Charleston, SC	1,550	81,874	233,424
Oakland, CA	1,901	296,661	1,387,611
Miami, FL	2,043	251,551	833,057
Fernandina Beach, FL	2,086	11,787	32,952
Portsmouth, VA	2,554	269,314	665,700
Newport News, VA	2,637	86,993	430,757
Wilmington, NC	2,690	60,308	115,057
Los Angeles, CA	2,918	362,397	1,124,493
Norfolk, VA	2,982	227,290	681,864
Boston, MA	3,084	495,679	1,466,233
Port Everglades, FL	3,927	175,320	714,176
Philadelphia, PA	5,878	50,687	1,915,775
Eddystone, PA	6,179	204,969	827,564
Galveston, TX	8,115	49,175	73,322
San Francisco, CA	9,671	592,869	1,265,529

even smaller doses beyond 16 km (10 mi). Therefore, DOE selected the 16 km (10 mi) radius population to represent the port populations most likely to be impacted by both incident-free transport and the entire range of potential port accidents.

It should be noted that while the populations within the 16 km (10 mi) radius include the populations within 0.8 km (0.5 mi) of the transportation route out to 16 km (10 mi) from the port and result in some double-counting of populations, the results provide only somewhat conservative estimates of the total affected population for each port/management site combination considered.

The populations along truck and rail routes are those computed in Appendix E for the transportation analysis impacts for incident-free transportation.

In summary, this evaluation considered the following population factors:

- Total 1990 Census population within a 16 km (10 mi) radius of the port facilities, and
- Total 1990 Census population within 0.8 km (0.5 mi) of the transport route that would be exposed during transport (from each port to each of the potential DOE management sites).

The statistical distribution of these combined populations for truck transport is shown in Figure D-6. The distribution exhibits some skewing due to a few very large port/site populations, such as around Boston, MA and Elizabeth, NJ. The statistical distribution of combined populations for rail transport is shown in Figure D-7, and again exhibits some skewing due to a few very high population ports. These port/site populations are not clearly normal and are better fit by a Poisson (so-called rare event) distribution, which is often the case for small sample sizes. However, for purposes of developing a systematic and fair method (i.e., one with minimal subjectivity) for evaluating port/site populations, DOE assumed, given the large uncertainty and variances for the small sample sizes for each port/site combined population, that the combined populations for truck transit and the combined populations for rail transit are approximately normal. The port/site population distributions for each of the five management sites (truck and rail routes) are shown in Figures D-8 through D-17, with the bounds associated with the mean plus and minus one standard deviation marked for reference.

For purposes of identifying an acceptable range of ports of entry for the receipt of foreign research reactor spent nuclear fuel, DOE assumed that port/site population combinations greater than approximately one standard deviation above the mean would not be desirable (i.e., about 84 percent of the port/site populations would exhibit statistically lower populations). Thus, the range of ports would include most of the 28 ports being considered, but avoid the extremely large populations around Boston, MA, Elizabeth, NJ, and Philadelphia, PA.

From the remaining 25 ports, DOE assumed that population combinations below the mean combined population would meet the low population criterion while combined populations above the mean would not. As seen in Figures D-8 through D-17, some unique port/site populations would be acceptable for several potential management sites, while other populations would have very limited utility. The potential usefulness of low population ports in relation to this EIS is addressed in Section D.1.9.6. This screening would result in the elimination of an additional five commercial ports and one military port from the list. These commercial ports are Baltimore, MD, and Long Beach, Los Angeles, Oakland, and San Francisco, CA. The military port is Military Ocean Terminal Bay Area in Oakland, CA. The results of the population screening are summarized in Figure D-18.

As previously discussed, the position of maritime experts (USMMA, 1994) is that all of the ports evaluated under the DOE-developed criteria for populations could safely receive and tranship foreign research reactor spent nuclear fuel to all five of the potential DOE management sites. Further, the EIS analyses show that the conservatively calculated impacts would be extremely low. The identification of a smaller number of preferred ports of entry is driven by the requirements of the National Defense Authorization Act, not by any significant safety issues.

As promised in the Urgent Relief Environment Assessment, DOE has also considered future population growth near potential port facilities over the time period considered in this EIS. Year 2010 estimates of projected growth from the 1990 census populations were provided by the states hosting the selected ports and other sources where necessary. Population growth patterns in port cities are continuously changing in ways that cannot be accurately forecast 10 or more years into the future. Nevertheless, the projected port populations based on these growth factors were scrutinized to be sure that no unacceptably large growth would occur around the list of ports selected under the DOE "lowest human population" criterion. The port growth factors used for projecting potential future impacts of port accidents are summarized in Attachment D2 to this appendix, and were used to make final port selections, where appropriate, as discussed in the next section.

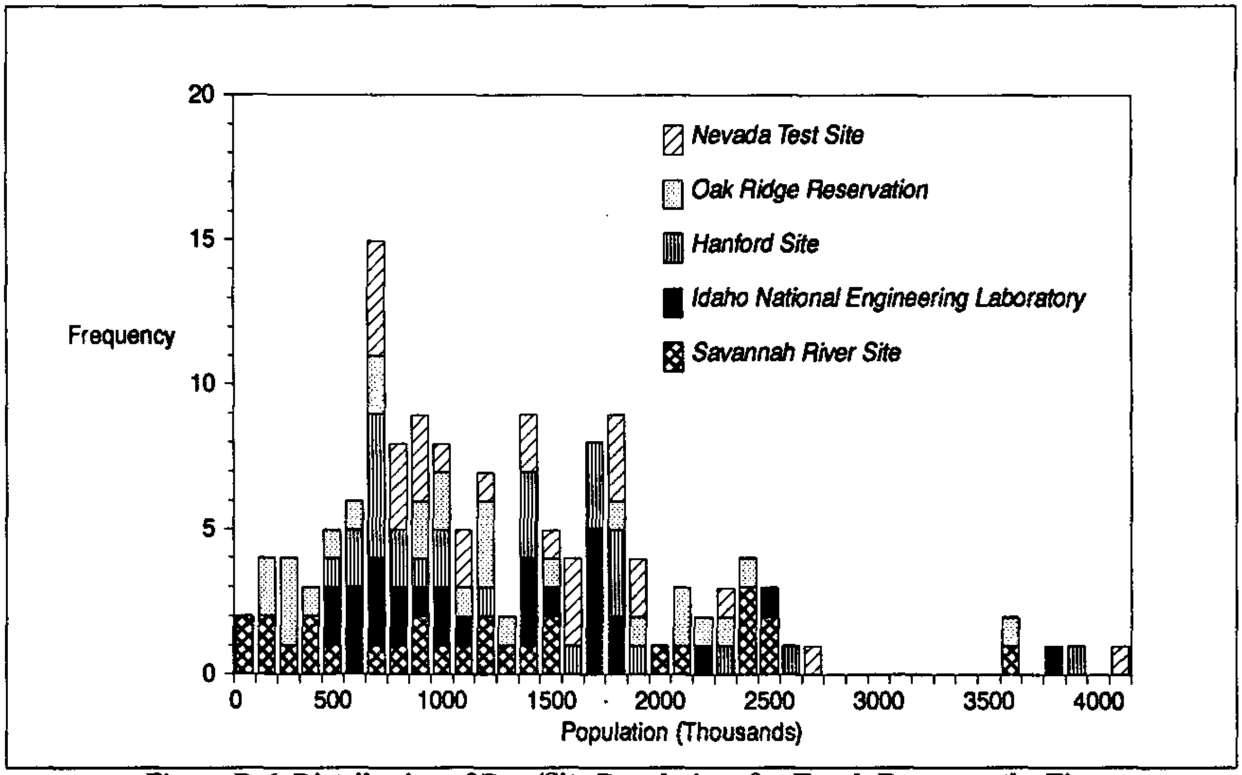


Figure D-6 Distribution of Port/Site Populations for Truck Routes to the Five Management Sites

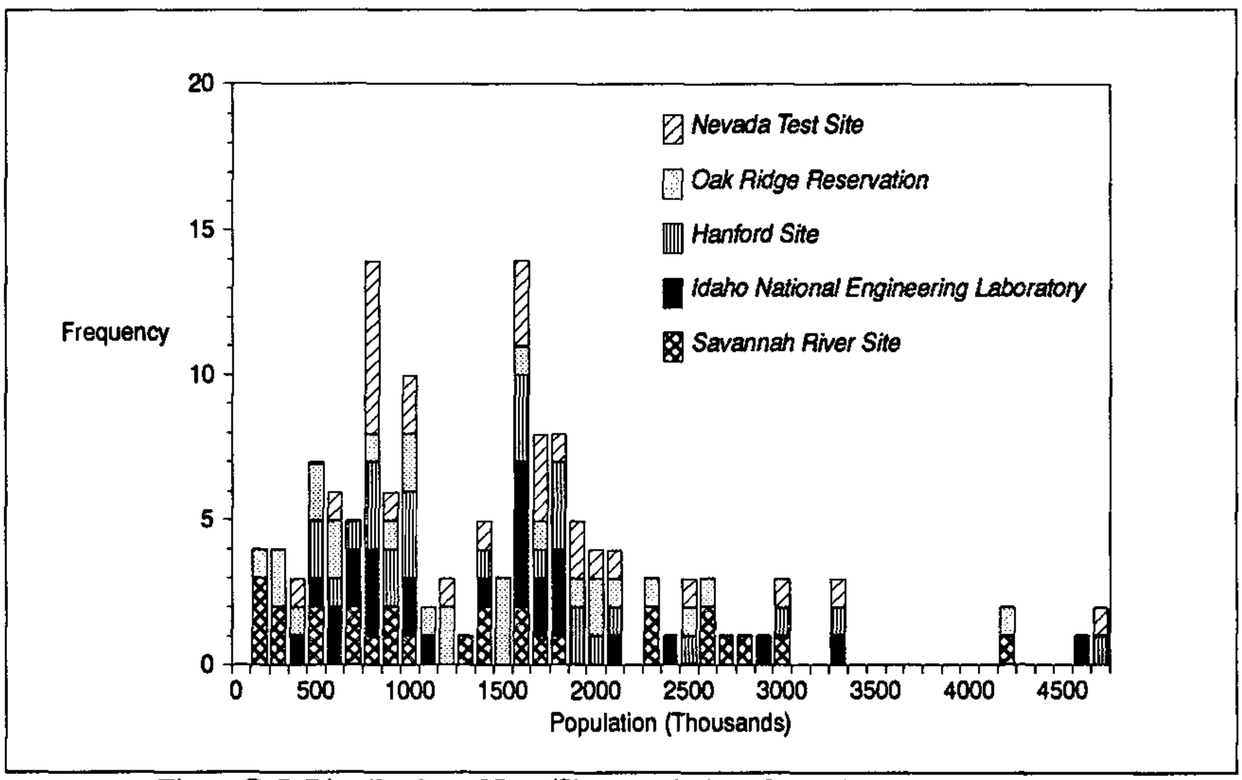


Figure D-7 Distribution of Port/Site Populations for Rail Routes to the Five Management Sites

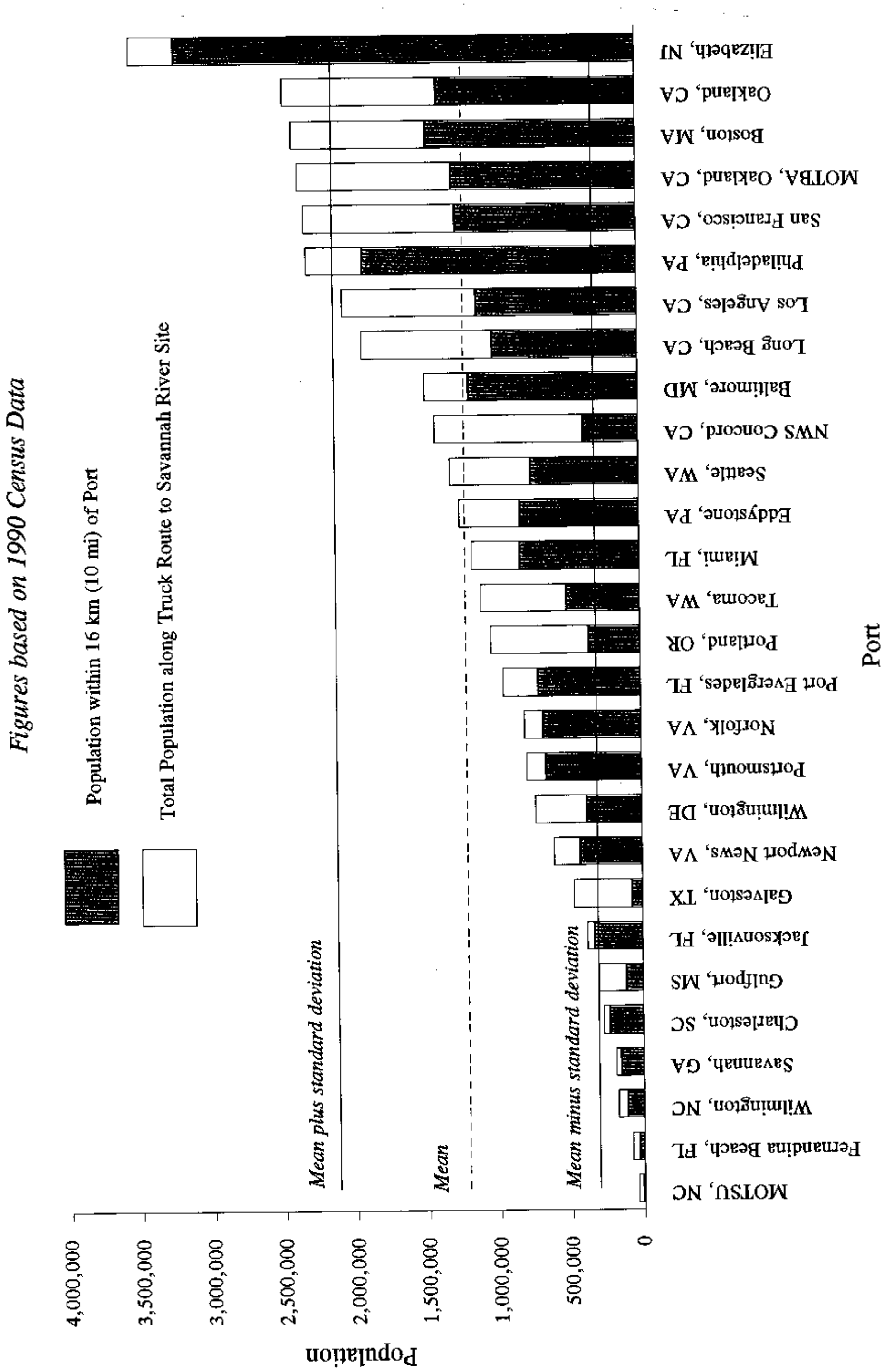


Figure D-8 Population Distribution for Savannah River Site by Truck

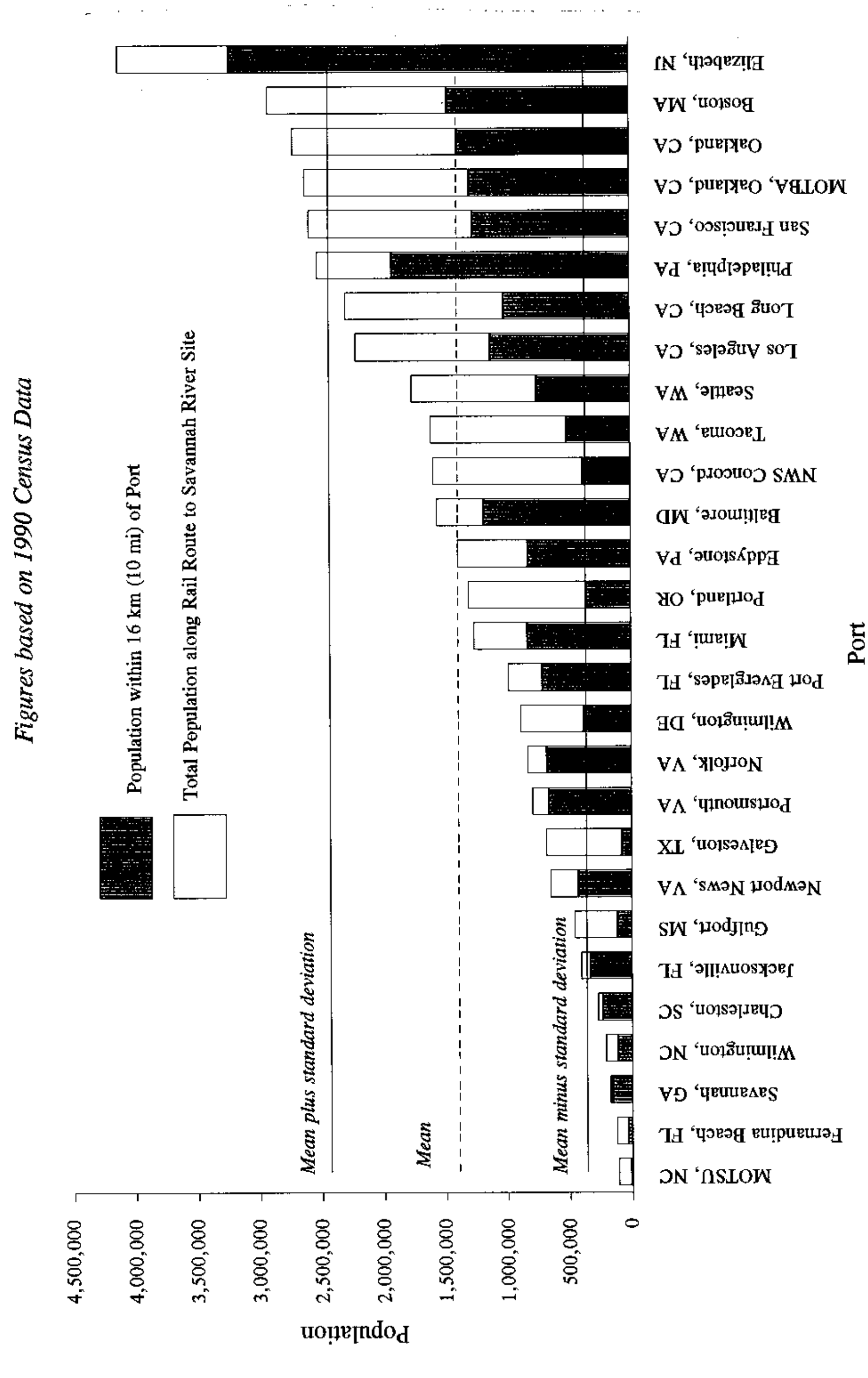


Figure D-9 Population Distribution for Savannah River Site by Rail

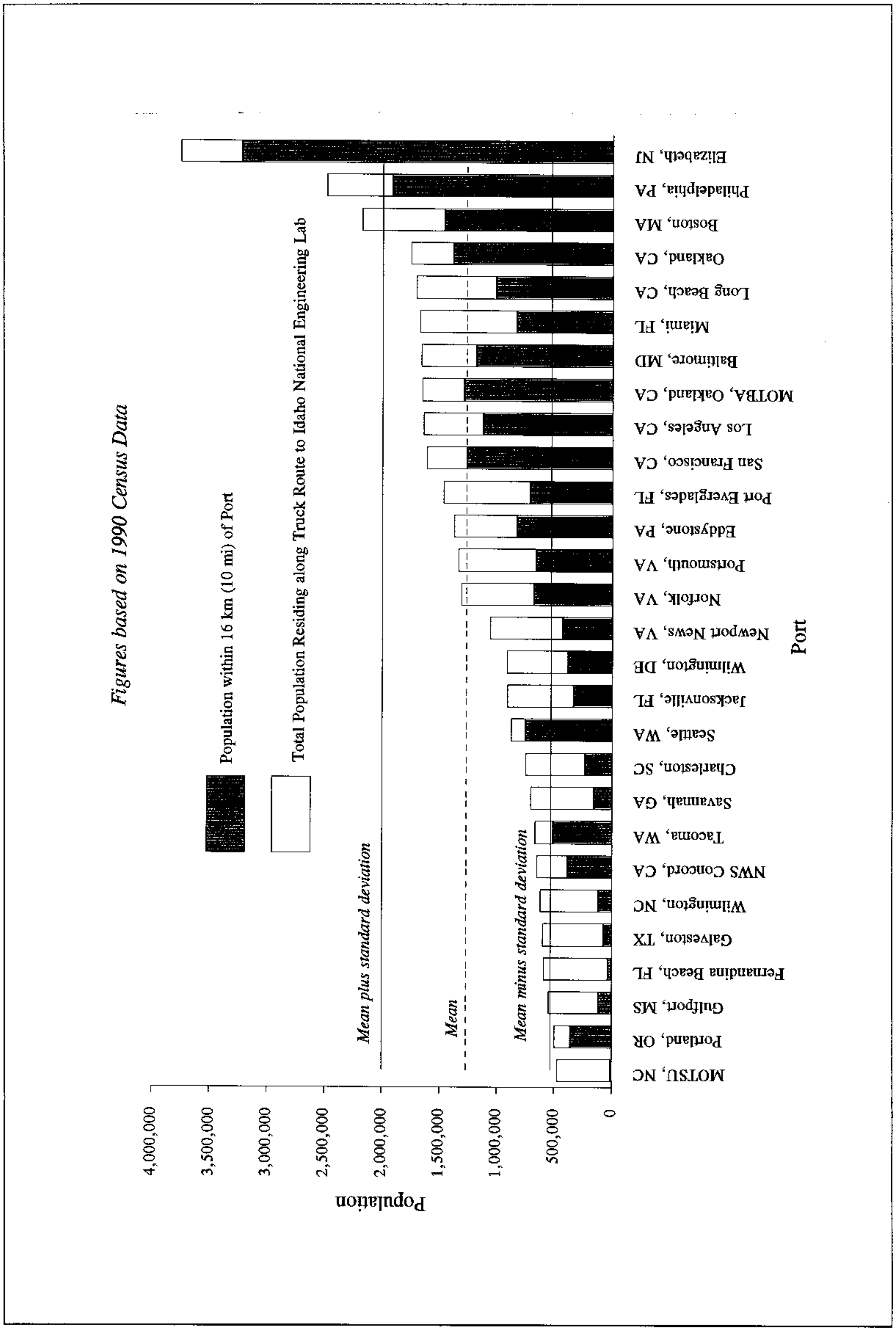


Figure D-10 Population Distribution for Idaho National Engineering Laboratory by Truck

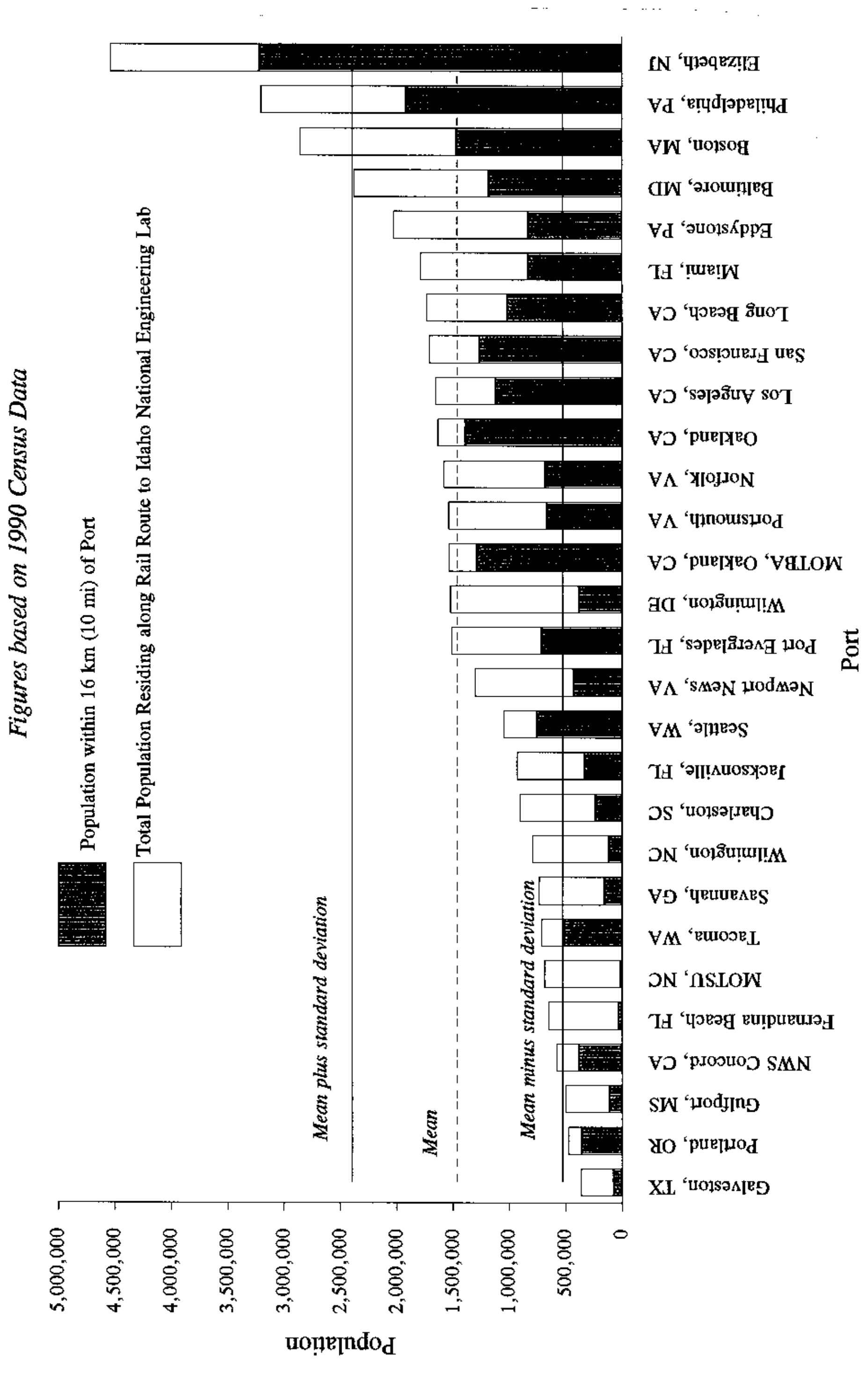


Figure D-11 Population Distribution for Idaho National Engineering Laboratory by Rail

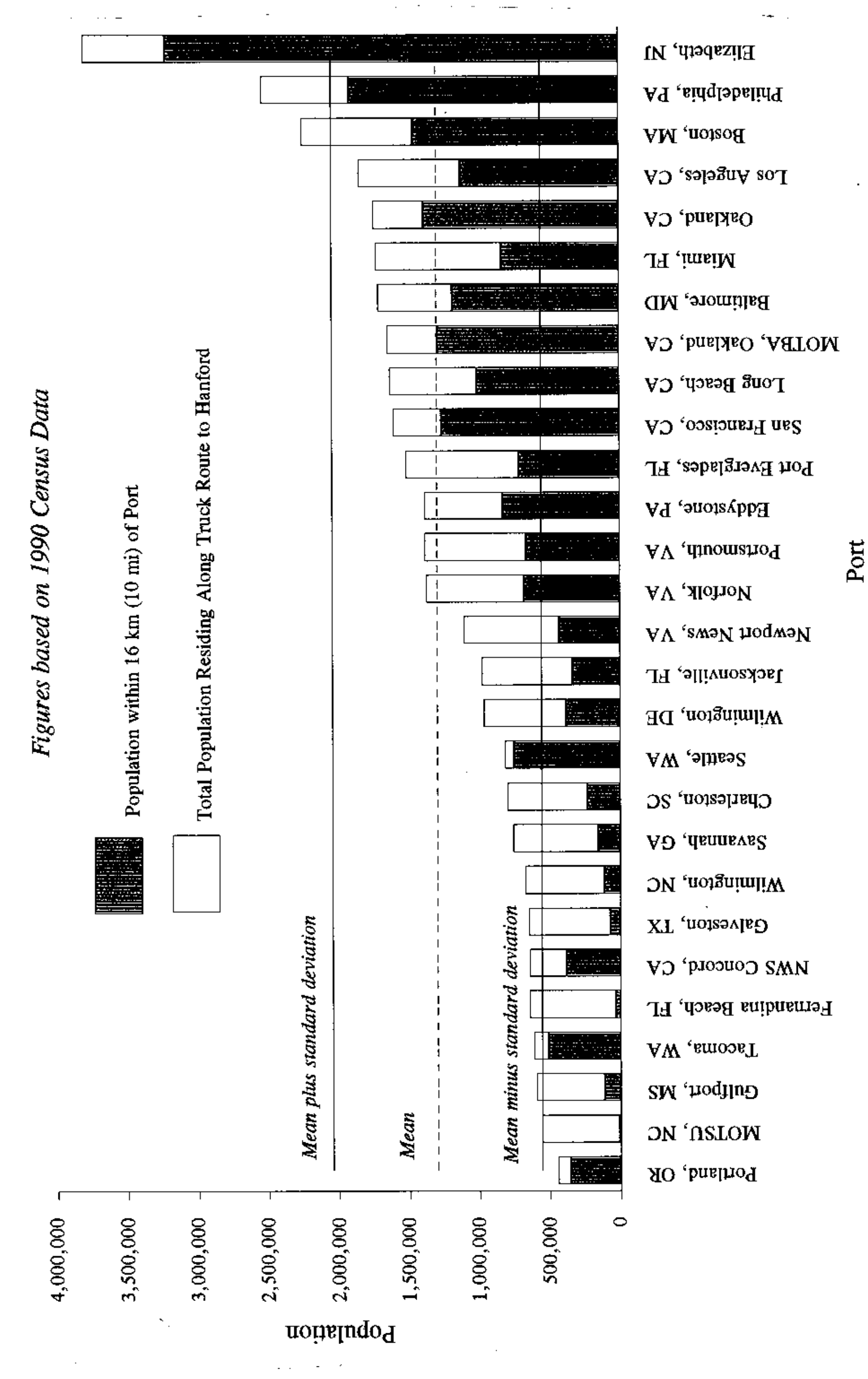


Figure D-12 Population Distribution for Hanford Site by Truck

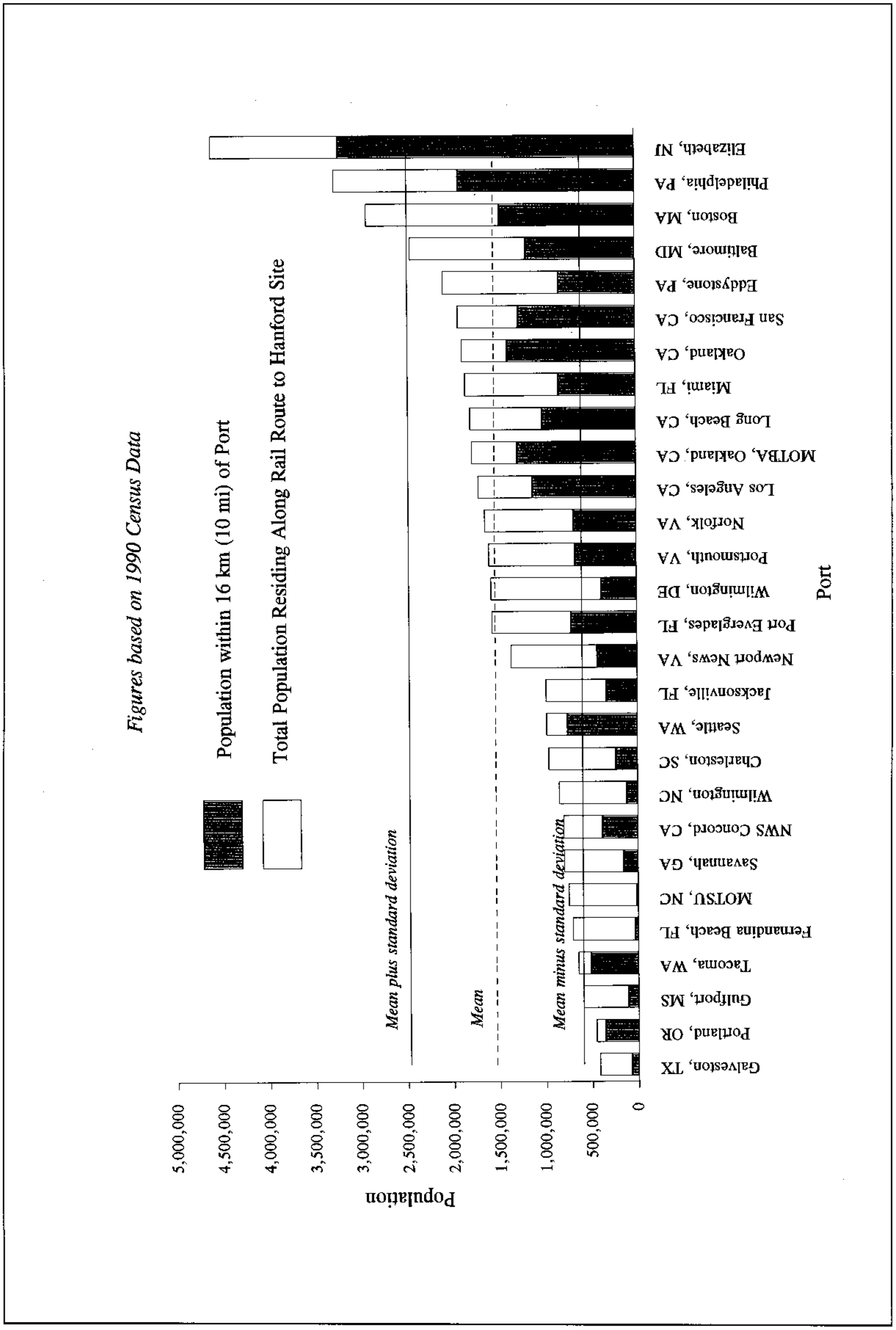


Figure D-13 Population Distribution for Hanford Site by Rail

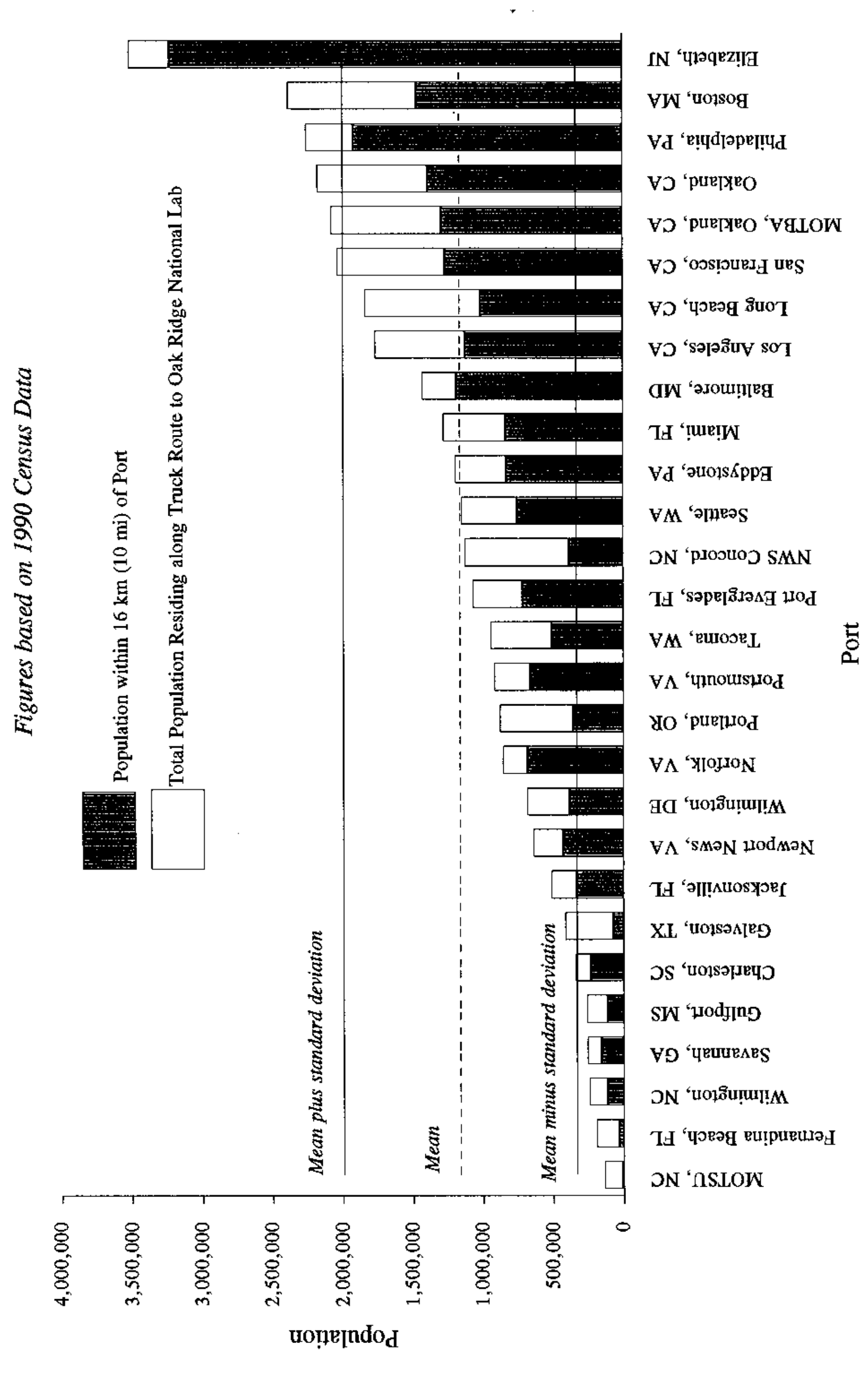


Figure D-14 Population Distribution for Oak Ridge Reservation by Truck

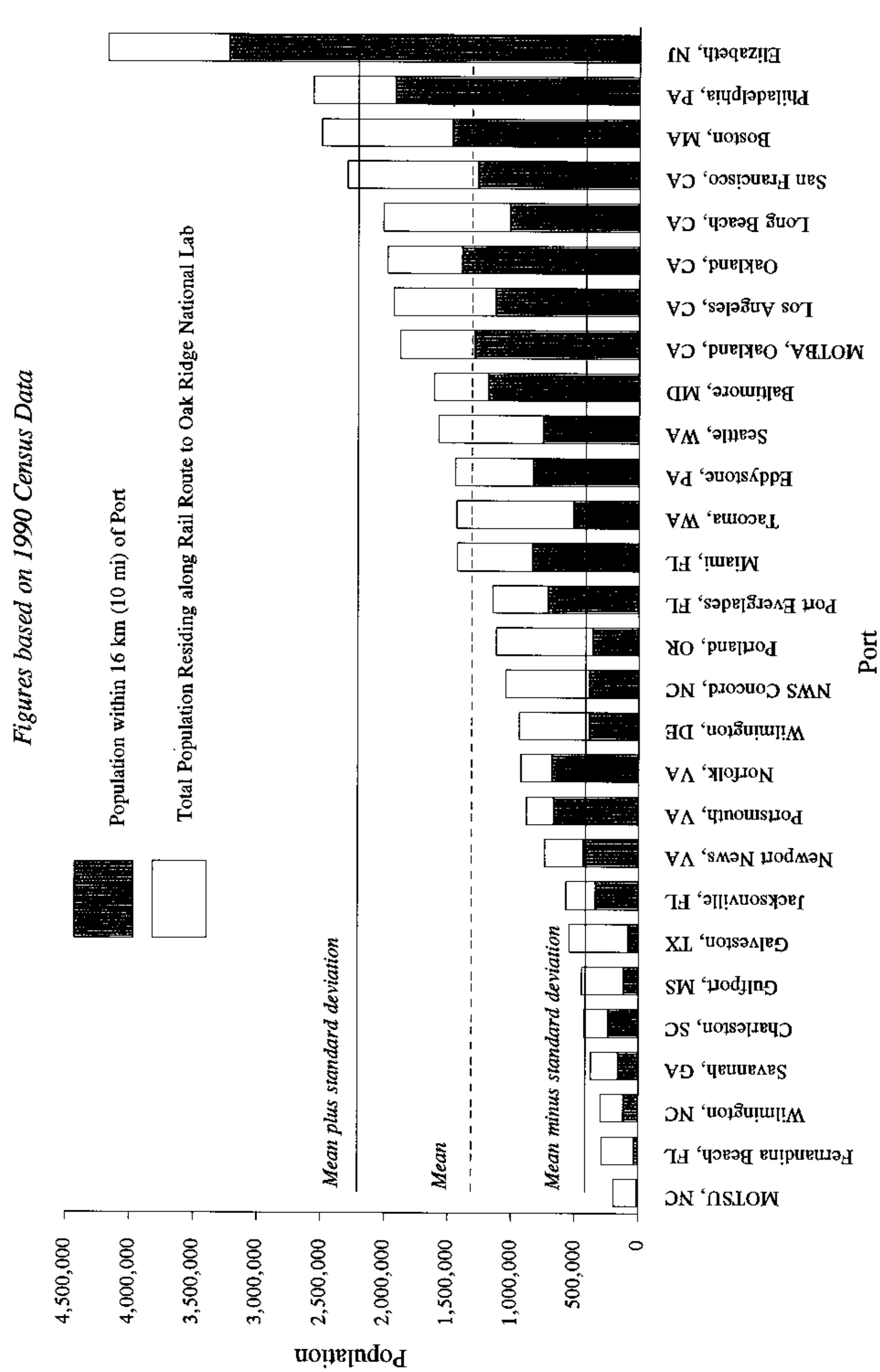


Figure D-15 Population Distribution for Oak Ridge Reservation by Rail

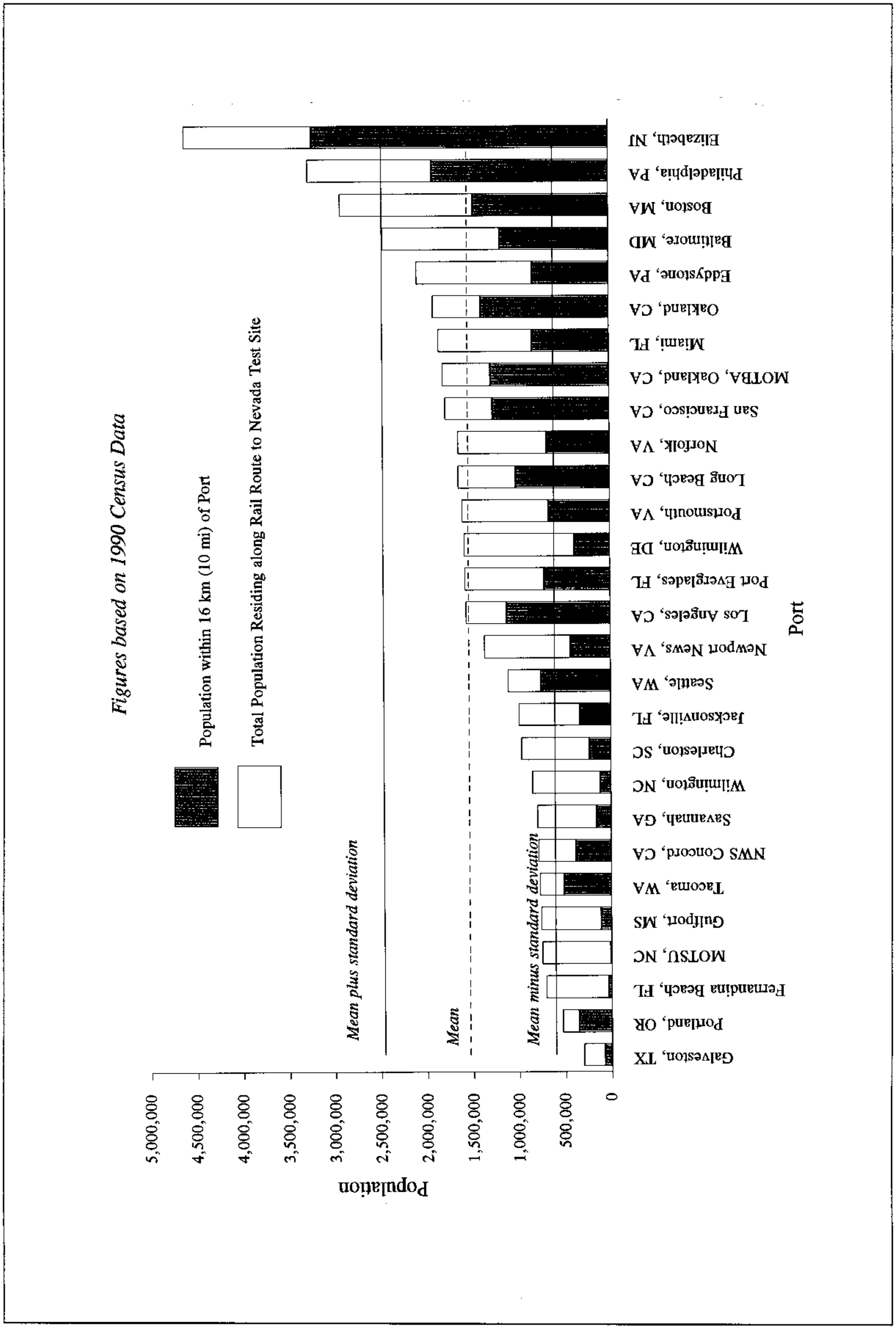


Figure D-17 Population Distribution for Nevada Test Site by Rail

❺ *Low Population Criteria:*

a. *Accepted 17 Commercial Ports:*

Charleston, SC
Eddystone, PA
Fernandina Beach, FL
Galveston, TX
Gulfport, MS
Jacksonville, FL
Miami, FL
Newport News, VA
Norfolk, VA
Port Everglades, FL
Portland, OR
Portsmouth, VA
Savannah, GA
Seattle, WA
Tacoma, WA
Wilmington, DE
Wilmington, NC

b. *Accepted 2 Military Ports:*

Military Ocean Terminal Sunny Point, NC
Naval Weapons Station Concord, CA

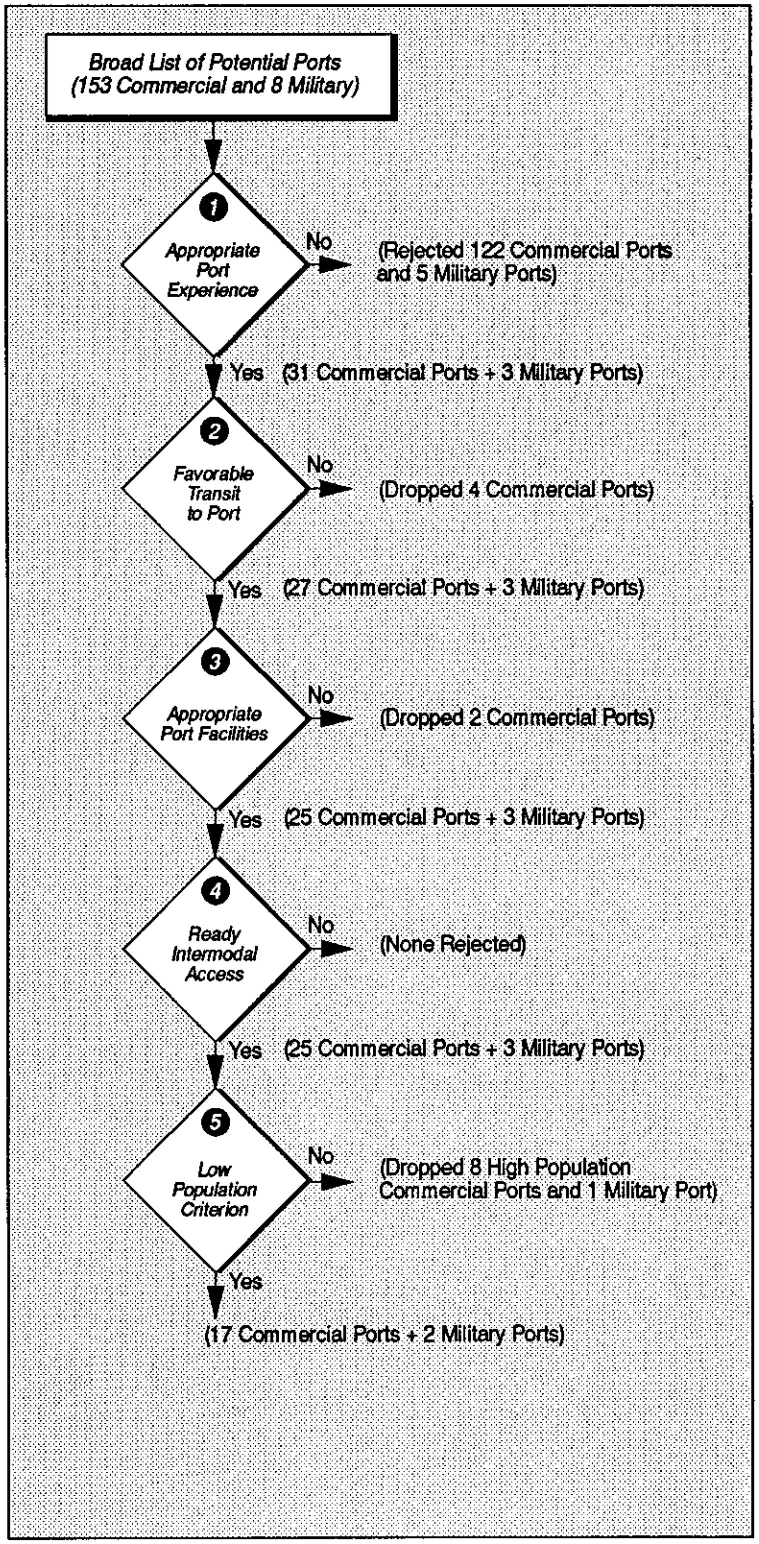


Figure D-18 Screening Ports for DOE "Lowest Human Population" Criteria

D.1.9.6 Desirable Port Attributes

As discussed in Section D.1.9, there are a number of desirable attributes that were not important enough individually to reject an otherwise acceptable port, but have been collectively used to select proposed ports from the list of ports found acceptable under the other DOE criteria. As an element of desirable attributes, DOE examined the likely usefulness of ports for foreign research reactor spent nuclear fuel shipments to any of the five DOE management sites.

The term "usefulness," as used here, is a relative term wherein the relative numbers of scheduled shipping lines and the types of ships that service each port and the countries served by those lines, are compared for two or more otherwise acceptable ports for purposes of selecting the best of that group. This helped to select the ports most likely to be useful in relation to this EIS. This information is shown in Table D-6.

In using these factors, the Ports of Newport News, Norfolk, and Portsmouth, VA, are examined as a single port: Hampton Roads, VA. Table D-6 shows the results of the evaluation of the low population ports for usefulness. The limited usefulness of a port for truck or rail access and service to the potential foreign research reactor spent nuclear fuel management sites eliminated the Ports of Eddystone, PA, Miami and Port Everglades, FL, Wilmington, DE, and Seattle, WA from further consideration.

DOE also identified the most desirable attributes of the remaining ports, such as terminals that do not have conflicting activities nearby (e.g., cruise ship lines, large tourist populations, large petroleum or petrochemical facilities, etc.), and are well-separated from high density populations, have secure short-term storage for contingencies, and have adequate emergency preparedness.

Absence of Conflicting Activities in Port Facilities

While it is the long-held position of DOE, Department of Transportation, and the NRC (NRC, 1977) that spent nuclear fuel shipped in certified Type B casks is well-protected from possible damage due to accidental cask drops, transportation fires, or immersion in water, DOE also concluded that the small public risks associated with such activities could be reduced further if the port in question also had no potentially dangerous, unavoidable conflicting activities, such as regularly scheduled transport of explosive or flammable cargoes, no petroleum carriers or storage facilities in the immediate vicinity of foreign research reactor spent nuclear fuel carrying vessels, and no large numbers of tourists in the immediate area of the terminal who could be unacceptably impacted by a severe accident (good planning and scheduling for arrival of foreign research reactor spent nuclear fuel carrying vessels could mitigate many potential conflicts). The absence of conflicting activities at potential commercial ports was considered in the final port selection to the maximum extent practicable.

A similar important factor for military ports is whether there is adequate separation of the potential port facilities to be used for receipt of the spent nuclear fuel from other hazardous activities (e.g., loading munitions). An exception would be military facilities that were designed and constructed to mitigate the potential impacts of explosions or fires at other piers. Two examples of such facilities which were accepted under the other DOE criteria are MOTSU, NC and the NWS Concord, CA, where such activities are routinely carried out with a high degree of safety. In addition, such conflicts can be avoided by scheduling foreign research reactor spent nuclear fuel shipments at times when no explosives are present at piers.

Table D-6 Relative Usefulness of Low Population Ports for Foreign Research Reactor Spent Nuclear Fuel Shipments

Ports-of-Entry	*Relative Usefulness by Storage Site*					*Relative Usefulness by Foreign Research Reactor Spent Nuclear Fuel Shippers*	
	SRS	*ORR*	*INEL*	*HS*	*NTS*	*Conventional Carriers*	*Charters*
Commercial							
East Coast							
Charleston, SC (Wando Terminal)	T&R	T&R	T&R	T&R	T&R	Europe, Far East, Japan, Australia	Yes
Eddystone, PA	R	No	No	No	No	Central/South America	Yes
Fernandina Beach, FL	T&R	T&R	T&R	T&R	T&R	South/Central America, Mediterranean (monthly)	Yes
Hampton Roads, VA	T&R	T&R	T&R	T&R	T&R	Most of the world	Yes
Jacksonville, FL	T&R	T&R	T&R	T&R	T&R	Most of the world	Yes
Miami, FL	T&R	No	No	No	No	Central/South America, Mediterranean, Mexico, Far East	Yes
Port Everglades, FL	T&R	T&R	No	No	No	South American, Northern Europe, Mediterranean, Mideast, Scandinavia	Yes
Savannah, GA	T&R	T&R	T&R	T&R	T&R	Most of the world	Yes
Wilmington, DE	T&R	T&R	T	T	T	Central/South America	Yes
Wilmington, NC	T&R	T&R	T&R	T&R	T&R	Northern Europe, Mediterranean, Mideast, East and South Africa, South America, Far East, Australia	Yes
Gulf Coast							
Galveston, TX	T&R	T&R	T&R	T&R	T&R	Northern Europe, Mediterranean, Mexico, South America, Central America	Yes
Gulfport, MS	T&R	T&R	T&R	T&R	T&R	Northern Europe, Central/South America	Yes
West Coast							
Portland, OR	T&R	T&R	T&R	T&R	T&R	Most of the Pacific Rim, Mediterranean	Yes
Seattle, WA	No	T	T&R	T&R	T&R	Most of the Pacific Rim, Mediterranean	Yes
Tacoma, WA	T	T	T&R	T&R	T&R	Most of the Pacific Rim, Mediterranean	Yes
Military							
MOTSU (NC)	T&R	T&R	T&R	T&R	T&R	None	Yes
NWS Concord (CA)	No	T&R	T&R	T&R	T&R	None	Yes

SRS = Savannah River Site, ORR = Oak Ridge Reservation, INEL = Idaho National Engineering Laboratory, HS = Hanford Site, NTS = Nevada Test Site; T = truck, R = rail

Emergency Response Capabilities

The U.S. Merchant Marine Academy Workshop identified the importance of a risk management staff and emergency response capabilities (including response plans and training of operating personnel) in determining the acceptability of ports for receipt and handling of foreign research reactor spent nuclear fuel. DOE focused on identification of ports that have current emergency response plans and personnel appropriately trained to respond to a port emergency to protect workers and the public from avoidable risks (however small). Since few ports have detailed response plans for radiological emergencies involving spent nuclear fuel, DOE determined that such shortcomings do not prevent consideration of such ports provided the ports have in place appropriate response plans and training for hazardous cargo accidents, since many of the features are the same (e.g., identification of decisionmakers, first responders, and support personnel to mitigate impacts of fires, etc.). In addition, for ports that have no specific response plans for spent nuclear fuel accidents in port, DOE could provide assistance in the development of radiological emergency response plans (in addition to existing hazardous cargo emergency response capability) and training at such ports in the event they were ultimately selected for foreign research reactor spent nuclear fuel shipments. Thus, appropriate plans and training would likely be in place prior to actual receipt of any such shipments. Ports having current emergency response capabilities were considered more desirable than those that do not.

Spent Nuclear Fuel Handling Experience

The National Defense Authorization Act would also require, "to the maximum extent practicable," that the ports selected for receipt of foreign research reactor spent nuclear fuel have spent nuclear fuel handling experience. At the present time, there are only a few ports in the United States with relatively recent experience handling either spent nuclear fuel or high-level radioactivity in Type B casks. As a result, this criterion, while desirable, unnecessarily restricts considerations to an unacceptably small group of potential ports, and strictly applied, could preclude shipments of spent nuclear fuel from some of the countries being considered under this EIS except by chartered ship. However, because all containerized cargoes are handled in the same manner as the containerized spent nuclear fuel would be handled, DOE concluded that current experience (especially any involving routine handling of potentially hazardous cargoes, or other radioactive cargoes in Type B casks) is much more important for public safety than foreign research reactor spent nuclear fuel handling experience in years past. This is especially true since the trained longshoremen are likely to have changed jobs, ports, or retired during the several years between the last shipments of spent nuclear fuel and the potential onset of future shipments under this EIS.

In addition, ports that have satisfied the "appropriate experience" and "port facilities" criteria are expected to be fully capable of currently handling spent nuclear fuel containers, and would gain experience as the program progressed.

Environmental Concerns Near Ports

Marine areas, immediately surrounding most of the ports considered in this selection process, tend to be severely impacted as a result of necessary periodic dredging or construction of new port facilities, including turning basins, high volumes of marine traffic, and routine port activities. As a result, ports generally are no longer environmentally sensitive areas within the context of NEPA. However, consistent with U.S. Merchant Marine Academy Workshop recommendations and in response to public comments, DOE decided that when special protected or sensitive areas were identified nearby the terminal(s) being considered, these areas would be identified in the EIS and used for final port identification as appropriate. No serious issues have been identified in the immediate vicinity of any ports selected under the DOE low population criterion review, with the possible exception of the NWS Concord, CA and Fernandina Beach, FL.

Environmental Concerns from Severe Natural Phenomena

Other factors that were considered desirable attributes for ports include average or lower risks from severe weather (e.g., extremely high winds, hurricanes, etc.) or other natural phenomena (e.g., seiches, earthquakes, volcanism, etc.). These attributes are not expected to be of great significance in practice, since the time involved with potential receipt and transhipment of containerized spent nuclear fuel represents such an extremely short period of risk (typically less than 24 hours), that the probability of severe natural phenomena impacting foreign research reactor spent nuclear fuel shipments is vanishingly small. Further, some natural events, such as hurricanes, can often be avoided. However, these characteristics were examined in conducting the port evaluation.

Separation of Port Facilities from Urban Populations

The following desirable characteristics are examined:

- Terminals used for spent nuclear fuel shipments should be physically separated from densely populated city centers (by several kilometers if possible) to help ensure that the general public would be unlikely to be exposed to significant radiation doses from either incident-free transport or accidents within the port (e.g., cask drops, fires, or truck or rail accidents, etc.).
- Transport of spent nuclear fuel through large, densely-populated, congested areas around the port should be avoided where practical.

These geographic/demographic characteristics, while not explicitly addressed in the evaluation of "lowest human populations" for ports, are implicitly included in the 16 km (10 mi) radius populations used for screening ports. While absence of these characteristics would not necessarily eliminate the use of such ports under this EIS, DOE reviewed these ports to determine if there were terminals or piers within the port that provided these characteristics. In many cases, development of new port facilities in recent years has resulted in specific terminals and/or piers that meet all of the required criteria (USMMA, 1994, and NDAA, 1993), and that also have most or all of the additional desirable characteristics (e.g., the Wando Terminal in Charleston, SC, the Blount Island Terminal in Jacksonville, FL, or Terminal T6 in Portland, OR).

Absence of Local Restrictions on Receipt and Handling of Spent Nuclear Fuel

Another desirable port factor recommended by the U.S. Merchant Marine Academy Workshop is the absence of local regulatory restrictions on receipt and handling of spent nuclear fuel. It is well established that local restrictions on international or interstate commerce are void under the U.S. Constitution, and similar challenges have been rejected by the Federal courts. For example, the Port of Oakland, CA indicated that a citizen's legislative initiative in 1987 led to a ban on the handling and transport of foreign research reactor spent nuclear fuel through the port. Although Oakland's ban was invalidated by the Federal District Court, the Port Authority has maintained some control over radioactive shipments through the port through its permitting system (Adams, 1993). Nevertheless, although claiming to be a "nuclear free zone," the port continues to allow permitted shipments of certain radioactive materials, handling approximately 500 metric tons (551 tons) of radioactive shipments between January and June 1994 (Adams, 1994).

Further, if DOE were to avoid selection of ports with restrictions by local ordinances, every port wishing to close its doors to receipt of spent nuclear fuel (or any other type of cargo) would simply promulgate an ordinance. Therefore, the EIS will only identify existing local restrictions (formal or informal) in section D.2 for consideration by decisionmakers, and this criterion will have no immediate impact on determination of the acceptability of ports within this EIS.

Secure Short-Term Storage

Although the National Defense Authorization Act requires, to the extent practicable, expeditious movement of casks from a port, the presence of regular guards, fences, and lighted areas that provide security at all times is a desirable attribute. Such additional features provide assurance of safe segregation and short-term storage of foreign research reactor spent nuclear fuel shipments away from workers and the public in the event of unexpected local occurrences, such as snow or ice storms, traffic congestion, and other events beyond the control of spent nuclear fuel shippers.

To best comply with this attribute, the storage area should be one designated for the storage of hazardous materials (referred to as a facility of particular hazard). Such designations are normally simple processes which result in U.S. Coast Guard approval following a request by the terminal operator. While all the military ports are designated as "facilities of particular hazard," some commercial facilities may only request periodic designations for specific incoming or outgoing cargoes (e.g., the Port of Tacoma, WA periodically designates Terminal 7B for occasional shipments of potentially explosive ammonium nitrate). Table D-7 shows which commercial ports have traditionally had secure storage areas for hazardous cargoes, and DOE has assumed such storage would be available in the future for receipt and short term storage of foreign research reactor spent nuclear fuel. (More detailed information on "facilities of particular hazard" may be found in section D.4.3).

D.1.10 Application of the Desirable Port Attributes in Port Selection

As a result of the evaluation of desirable attributes, two additional ports, Fernandina Beach, FL, and Gulfport, MS, were removed from the potential ports of entry list (Table D-7). The port of Fernandina Beach, FL, is not well-separated from the urban population surrounding the port, and the population is expected to substantially grow by about 82 percent by the year 2010 (see Attachment D2). Also, entry to the port requires ship passage through a State sea manatee (an endangered species) preserve. The Port of Gulfport, MS, does not currently have a well-secured area designated for the storage of foreign research reactor spent nuclear fuel, and it is unlikely it ever will due to casino operations. There is a former cruise ship terminal at the East Pier, which is slated for new casino development, a floating casino located in the port and two new casinos on the West Pier. In addition, the port is not well-separated from surrounding urban population.

Conclusion

As a result of the evaluation, ten ports remained as the final list of ports acceptable for the potential receipt, handling, and transhipment of foreign research reactor spent nuclear fuel. These ten ports [Charleston, SC; Galveston, TX; Hampton Roads (includes terminals in Newport News, Norfolk, and Portsmouth), VA; Jacksonville, FL; MOTSU, NC; NWS Concord, CA; Portland, OR; Savannah, GA; Tacoma, WA, and Wilmington, NC] represent the final list of ports considered for the receipt of foreign research reactor spent nuclear fuel.

D.2 Detailed Information on Potential Ports of Entry

This section of Appendix D provides detailed information that served as the bases for identifying the candidate ports addressed in Section D.1. For convenience, the port details are divided into two categories: (1) the DOE candidate ports of entry that met the criteria developed for port identification in Section D.1, and (2) the remainder of the ports that fully or marginally satisfied the first criterion for appropriate port experience. Within each of the categories, the ports are arranged in alphabetical order. The location of the ports is shown in Figure D-1.

Table D-7 Use of Desirable Attributes for Selecting Final "Low Population" Ports for Foreign Research Reactor Spent Nuclear Fuel Shipments

Ports-of-Entry	*Free of Conflicting Uses at Port Facilities*	*Emergency Preparedness*	*Short-Term Secure Storage*	*Free of Environmental Concerns*	*Free of Severe Natural Phenomena*	*Terminal Well-Separated from High Density Populations*
Commercial						
East Coast						
Charleston, SC	Yes (Wando)	Yes	Yes	Yes	E, H	Yes (Wando)
Fernandina Beach, FL	T	Yes	No	Some (Manatee)	H	No
Hampton Roads, VA	Yes	Yes	Yes[b]	Yes	Yes	Yes (Newport News, VA)
Jacksonville, FL	Yes (Blount Island)	Yes	Yes	Yes	H	Yes (Blount Island)
Savannah, GA	P	Yes	Yes[b]	Yes	E, H	Yes (Container Port)
Wilmington, NC	P, Some Ex[a]	Yes	Yes[b]	Yes	H	Yes
Gulf Coast						
Galveston, TX	Some P, T, Ex[a]	Yes	Yes[b]	Yes	H	No
Gulfport, MS	T[c]	Yes	No	Yes	H	No
West Coast						
Portland, OR	Yes	Yes	Yes[b]	Yes	E, V	Yes (T6)
Tacoma, WA	Yes, some Ex[a]	Yes	Yes	Yes	E, V	Yes
Military						
MOTSU (NC)	Ex[a]	Yes	Yes	Yes	H	Yes
NWS Concord (CA)	Ex[a]	Yes	Yes	Some (wetlands and Tule elk)	E	Yes

Ex= explosives, T = tourism, P = petroleum handling/storage facilities, H = hurricanes/tropical storms, V = volcanoes, E = earthquakes

[a]*Separation of piers and scheduling of spent nuclear fuel and explosive shipments on different days makes consideration of these ports appropriate*

[b]*No currently designated facilities of particular hazard at preferred terminal(s)*

[c]*Extensive casino development within 1,000 feet*

D.2.1 Detailed Information on Candidate Ports of Entry

D.2.1.1 Charleston, SC (Includes the Naval Weapons Station Terminal and the Wando Terminal)

Charleston is the largest port city in South Carolina, and the greater Charleston area is one of the major seaports on the East Coast of the United States. The city of Charleston itself is located at the confluence of the Cooper and Ashley Rivers, approximately 11 km (7 mi) from the entrance from the sea. The principal wharves are along the west bank of the Cooper River except for the Wando Terminal which is along the east bank of the Wando River near Mount Pleasant, about 20 km (11 mi) from the Atlantic Ocean. The city is the center of a rich agricultural district for which it is the distribution point. The entrance to the harbor is maintained by a Federal project providing a channel depth of 10.7 m (35 ft) over the bar, through the entrance and into the major reaches of the Cooper River. The harbor is easy to access in day or night in clear weather, and is one of the best harbors of refuge on the South Atlantic coast (DOC, 1993d). The maps of the port are shown in Figures D-19 (Naval Weapons Station, Charleston) and D-20 (Wando Terminal).

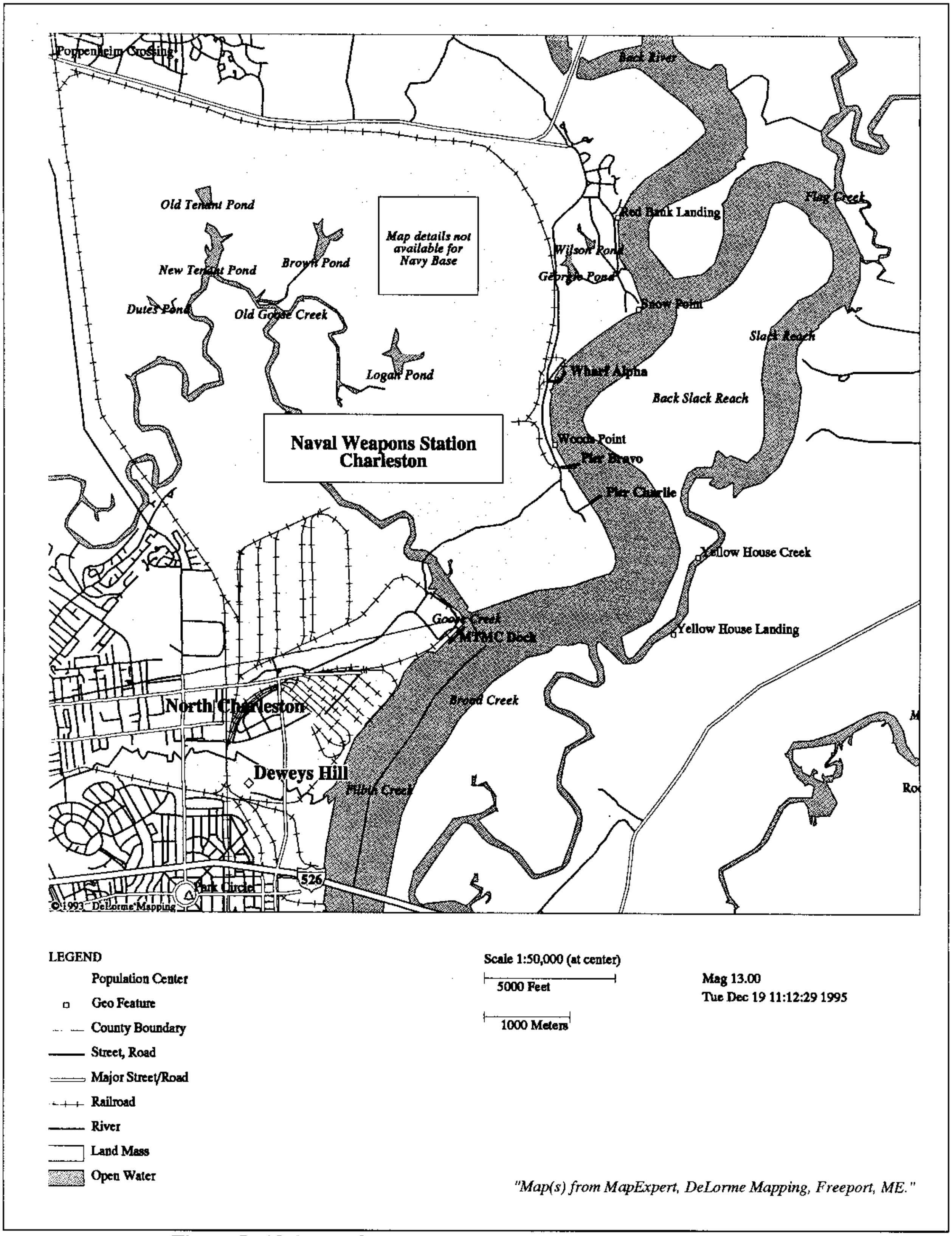


Figure D-19 Map of the Naval Weapons Station, Charleston, SC

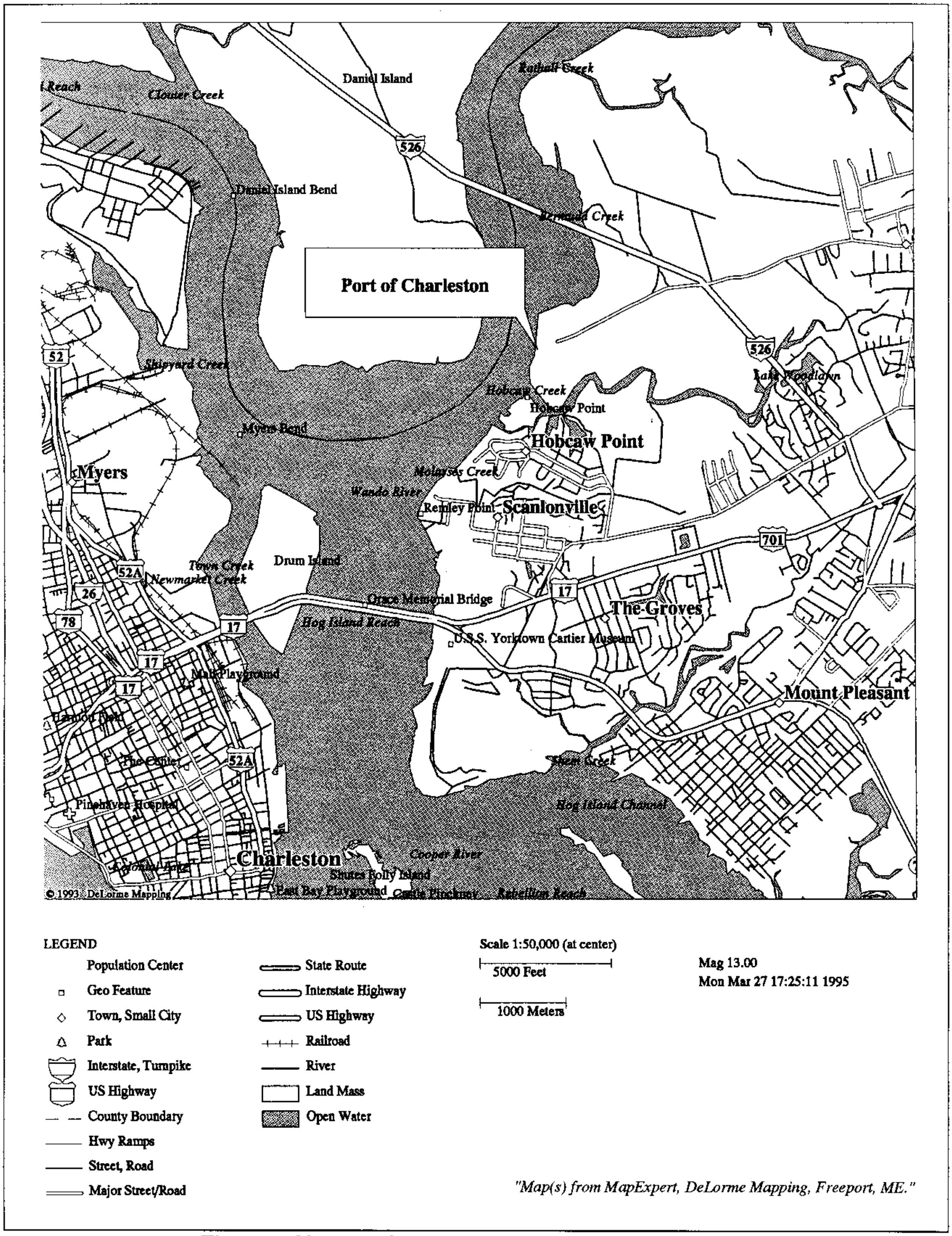


Figure D-20 Map of the Wando Terminal, Charleston, SC

However, the areas to the east and southeast of the port entrance are used extensively by the U.S. Navy and other military services for training exercises which may result in occasional restrictions. Under unfavorable weather conditions current velocities in some areas have been reported as high as 2.1 meters-per-sec (4 knots) (DOC, 1993d). All of the port terminals have 12.2 m (40 ft) of water alongside at mean low water. The port is serviced by many of the world's largest container shipping lines (a total of 56), that handled 807,106 standard 20-ft container equivalents in 1991 (AAPA, 1993; FHI, 1993a). These lines provide service between Europe, the Far East, Japan, Australia and other countries (Jane's, 1992).

The South Carolina State Ports Authority owns and operates four large general cargo and container terminals within the greater Charleston area. The City of Charleston hosts two facilities (Union Pier Terminal and Columbus Street Intermodal Terminal) that were eliminated from consideration because they are not well separated from dense urban populations, and are within the city limits and subject to potential restrictions on receipt and handling of spent nuclear fuel (Jane's, 1992; AAPA, 1993).

The North Charleston Terminal is a container terminal located about 16 km (10 mi) upstream from the city of Charleston. This facility was considered to be inferior to the Wando Terminal because it requires additional transport up a heavily trafficked and more confining channel (only about 120 m (or 400 ft) wide in many reaches) on the upper Cooper River, with ships required to pass below an additional bridge (I-526) over the river (in comparison to Wando Terminal). Further, superior facilities and better separation from populated areas are found at the Wando Terminal discussed below.

In the Draft version of this EIS, only the Wando Terminal was addressed in detail. Public commentors from the Charleston area and other candidate port areas suggested that DOE further consider military ports. Since the Draft EIS was published, the Record of Decision for the SNF&INEL Final EIS (DOE, 1995) directs all aluminum-based spent nuclear fuel to the Savannah River Site. Because of the public requests and the relative proximity of the Savannah River Site to the greater Charleston area, the NWS Charleston has been added as a candidate port of entry, and detailed information is provided in the following section.

Other Pertinent Information: The City of Charleston has a city ordinance restricting the transport of spent nuclear fuel through the city. According to information gathered, the ordinance does not preclude shipment, but requires a permit and approval from the city. The Sandia National Laboratories Radioactive Materials Postnotification Database indicates that the port has not received any spent nuclear fuel since the database was initiated in October 1984 (SNL, 1994), and the NRC has no record of foreign research reactor spent nuclear fuel shipments since 1979, when NRC began approving spent nuclear fuel shipments (NRC, 1993). From discussions with senior port officials, it was determined that Wando Terminal would handle spent nuclear fuel shipments provided they had the approval of the U.S. Coast Guard Captain of the port and the Charleston Fire Department (Moise et al., 1993). Use of City terminals, rather than the Wando Terminal, has the potential for delays in the receipt and transhipment of foreign research reactor spent nuclear fuel, which could result in failing to move the foreign research reactor spent nuclear fuel from the port of entry to the management site "expeditiously." The NWS Charleston is capable of handling spent nuclear fuel shipments provided that the NWS Charleston receives appropriate program "Waivers". A program waiver would have to be issued by the Chief of Naval Operations to allow NWS Charleston facilities to be used to handle spent nuclear fuel shipments. Event waivers would have to be issued by the NWS Charleston Commanding Officer to allow each shipment to be handled. Event waivers are routine procedures used by the NWS Charleston Commanding Officer to place restrictions on conflicting activities, such as ammunition handling (Stark, 1995).

The South Carolina State Ports Authority Port Police are part of an emergency response team comprised of the local fire departments, Coast Guard, and private hazardous materials response organizations. The Ports Authority provides operating personnel basic hazardous materials training. Dock workers are trained in hazardous materials placard recognition and other basic information by the port's stevedores. Security is provided by perimeter fencing with controlled access and the South Carolina State Ports Authority Police Force, which maintains 24-hour manned access booths, patrols, and surveillance. All container terminals have secure, open and/or covered storage space for temporary storage of spent nuclear fuel if necessary (Moise et al., 1993).

The Wando Terminal is located several kilometers northeast of downtown Charleston in a relatively low population area with good access to interstate highways. Aside from general environmental concern for the wetlands around the port, there are no known special sanctuaries or habitats of concern although the port is subject to severe hurricanes (with high water) and tropical storms. It was the site of the largest earthquake (Modified Mercalli Intensity X) in the Eastern United States in recorded history, on August 31, 1886 (Bolt, 1978). The likelihood of severe natural phenomena such as high winds and earthquakes is reflected in the structural requirements for buildings in each area of the United States. These are shown in the Uniform Building Code (UBC, 1991). For the Port of Charleston, the Uniform Building Code requires buildings to withstand wind speeds up to 160 km/hr (100 mph). The port is located in a moderate seismic zone with an acceleration of 0.15 g.

There are several tanker terminals and petroleum storage depots along the west bank of the Cooper River downstream of the North Charleston Container Terminal (which is also immediately adjacent the Naval Weapons Station off Goose Creek). However, there do not appear to be any conflicting cargoes or activities at the Wando, Columbus, or Union Pier Terminals. The port officials contacted indicated that they believe that radioactive shipments have been made through the port in the past, but they were not sure if spent nuclear fuel had been handled (Moise et al., 1993).

Environmental Conditions

The State of South Carolina has given the lower portion of the Wando River two different water quality classifications. The water is classified as SFH or SA. SFH waters are shellfish harvesting waters and SA waters are suitable for primary and secondary recreation and for other water uses requiring lower quality. According to the U.S. Fish and Wildlife Service's Ecological Inventory Map for James Island, SC, the Wando Terminal and the NWS Charleston are located in a mid-salinity estuarine habitat (generally 5 to 16.5 parts per thousand). The Charleston Harbor, which is traversed on the way to either terminal, is located in a high-salinity estuarine habitat (generally 16.5 to 30 parts per thousand) (FWS, 1980b).

The State of South Carolina has also classified the water quality of the portion of the Cooper River above the confluence with the Ashley River as SB (SB waters are tidal saltwaters suitable for secondary contact recreation, crabbing, and fishing, except the harvesting of clams, mussels, or oysters for market purposes and human consumption). The waters of Goose Creek, upstream of the confluence with the Cooper River to the dam at the Charleston Waterworks, are also Class SB (Department of the Navy, 1994).

The lower Wando River, the Charleston Harbor, and the NWS area support a large number of aquatic and terrestrial species. According to the South Carolina Heritage Trust, no rare, threatened, or endangered species or communities have been recorded in the area near the Wando Terminal (McBee, 1994). State or Federally protected endangered or threatened aquatic species in the vicinity of the Charleston Harbor include the Shortnose sturgeon, Atlantic sturgeon, and the American shad. Bachman's warbler is a Federally protected bird species also found in the vicinity (FWS, 1980b).

In addition, the U.S. Fish and Wildlife Service reports that several protected marine species are known to occur in Charleston County (Banks, 1994). These are the west indian manatee (endangered), Kemp's ridley sea turtle (endangered), leatherback sea turtle (endangered), loggerhead sea turtle (threatened), and the green sea turtle (threatened). Protected bird species include the arctic peregrine falcon (threatened), bald eagle (endangered), wood stork (endangered), red-cockaded woodpecker (endangered), and the piping plover (threatened).

In recent years, two pairs of bald eagles (*Haliaeetus leucocephalus*) nested on the NWS Charleston. One nest was located north of Foster Creek near the POMFLANT storage and activity area, over four miles north of Wharf Alpha. The other was located on the golf course west of Pier X. Their nest tree was destroyed by Hurricane Hugo and the pair have relocated to Big Island, located north of Foster Creek (Department of the Navy, 1994).

Prior to Hurricane Hugo, 12 colonies of red-cockaded woodpeckers, *Picoides borealis*, were known at the NWS Charleston. The red-cockaded woodpecker requires mature pines old enough to be susceptible to red heart disease, which makes the wood soft enough for these small woodpeckers to create a cavity. Such trees are generally at least 70 to 75 years old. Nearly all trees this age were destroyed by Hurricane Hugo, so it is unlikely that the colony could reestablish at this site in the near future (Department of the Navy, 1994).

Wetlands are plentiful on and adjacent to the NWS Charleston. Three basic habitat types found within the area's wetland ecosystem are forested wetlands, nonforested wetlands, and open water. The station's wetland habitats had previously been identified according to the National Wetland Inventory classification system. Within this classification system, the station's wetlands had been placed in four major categories: estuarine, palustrine, lacustrine, and riverine. Based upon that classification, the station contained 1,356 acres of estuarine, 1,730 acres of palustrine and 131 acres of lacustrine wetlands (Department of the Navy, 1994). Field investigations have been performed at the NWS, and no rare or endangered plants or animals were observed (Department of the Navy, 1990 and 1994).

Wetlands at the station contain potential habitat for the flatwoods salamander (*Ambystoma cingulatum*), which is pending placement on the threatened or endangered species list. However, two spot checks of the area by the NWS Charleston environmental personnel have failed to locate either adults or larvae. It has been indicated that a detailed study may be performed of the area in the future (Department of the Navy, 1994).

Climatic Conditions

In general, the elevation of the area ranges from sea level to approximately 6 m (20 ft) on the peninsula. The climate of this region is temperate, primarily due to its close proximity to the Atlantic Ocean. The prevailing winds are generally northerly in the fall and winter months, becoming more southerly during the summer months. This type circulation serves to "warm" the region during winter and "cool" it during the summer. Summer is the rainy season in Charleston, with the city receiving 41 percent of the annual total rainfall during these months. Except for the occasional tropical storm or hurricane, the majority of this rain occurs during afternoon and evening thunderstorms. The late summer and early fall brings the highest probability of tropical storm activity to the Charleston, SC area. The fall season is a transitional period, where temperature extremes are rare and sunshine is abundant. The winters in this area are mild with periods of rain. However, in contrast to the summer, the winter rains tend to be steady and uniform, and last for several days. The most unstable period in this region is spring when the confluence of warm moist tropical air and cool dry continental air increase the occurrence of severe weather in this region. The average earliest freeze in this area is in early December and the average last frost is in late February (NOAA, 1992c).

D.2.1.1.1 Naval Weapons Station - Charleston

The NWS Charleston is located on the west bank of the Cooper River, north of the city of North Charleston in southeastern Berkeley County, South Carolina. The station occupies about 7080 hectares (17,500 acres) along a 14-km (9-mi) stretch of the Cooper River, starting about 30 km (19 mi) from the Atlantic Ocean. The primary missions of the NWS Charleston are to provide material support for assigned weapons and weapon systems, to provide housing and community support facilities for personnel assigned to the Charleston area, and to do additional tasks such as home porting and logistics support for ammunition ships, and other fleet and shore activities dealing with weapons. Major tenant activities on the station include the new Army Strategic Mobility Logistics Base, a Propulsion Training Facility and the Military Traffic Management Command, an Army organization (Department of the Navy, 1990 and 1994). The Army Strategic Mobility Logistics Base is being constructed on the formerly Polaris Missile Facility Atlantic site (Lewis, 1995).

In selecting a port this far from the open ocean, DOE considered the navigation safety through the Charleston Harbor and up the Cooper River. As previously described, the harbor experiences a significant amount of deep draft traffic, and is accustomed to managing ship traffic in several 10.7 m (35 ft) deep channels. The Navy maintains a 10.7-m (35-ft) deep channel up the Cooper River to all relevant piers and wharfs of the NWS. The channel is as narrow as 120 m (400 ft) in some areas and extends to the edge of piers that may be in use for handling ammunition, petroleum products or other hazardous cargo (DOC, 1993d). However, with proper management of the harbor by the U.S. Coast Guard and pilots, and the proper planning by the U.S. Navy, additional assurance of a safe transit can be provided.

The Charleston Harbor Navigational Guidelines (DOC, 1993d) identifies areas of particular concern in the Cooper River area and provides guidelines for navigation, overtaking and passing in these areas. The Charleston Branch Pilots Association procedures (Commissioners of the Pilotage, 1995) require strict adherence to these guidelines for deep draft vessels and vessels carrying hazardous materials. The Coast Guard Captain of the port has broad regulatory authority over all port activities, and procedurally delegates control of vessel movements to the Charleston Branch Pilots Association (Bennett, 1995). This authority includes activities ranging from minor additional traffic restrictions on passing to establishing and enforcing a moving safety zone around a ship traversing the harbor area. A moving safety zone requires advance notification in the *Federal Register*, but is routinely done in areas in which hazardous materials are carried (USCG, 1994c). The Coast Guard and the South Carolina State Police have conducted exercises on moving a ship up the Cooper River under the threat of terrorist activities (Millar, 1995).

The U.S. Navy is the only significant user of the Cooper River north of the North Charleston facilities, and is a major user of the Cooper River. Cooper River transits can be planned by the Navy so that they would not conflict with other Naval activities and ship movements. The Commanding Officer of the NWS Charleston would determine which facility is most appropriate for each shipment based on the characteristics of the vessel carrying the fuel, the planned mode of overland transportation and any conflicting activities at the NWS Charleston. The NWS Charleston has four facilities that can handle spent nuclear fuel. The northern facility is Wharf Alpha, which is more than 12 m (40 ft) wide and has about 300 m (1000 ft) of useful berthing area dredged to 12.3 m (40 ft) deep. Wharf Alpha was previously used to service Polaris missile-carrying nuclear submarines, including removal and replacement of nuclear missiles. This function is no longer necessary, and submarines do not regularly visit the NWS Charleston.

Wharf Alpha is currently being used to service and load U.S. Navy ammunition ships. With the construction of the Army Strategic Mobility Logistics Base, the Army plans to upgrade in 1998 the rail lines serving Wharf Alpha as well as expanding the wharf itself. The wharf has a mobile crane, and is served by truck and rail loops, meaning that either trucks or trains can drive directly onto the wharf, load, and exit without turning around or reversing direction. Pier Bravo, located about 1 km (3281 ft) south of Wharf Alpha, is also used for ammunition handling. Pier Bravo protrudes 300 m (983 ft) into the Cooper River, with 214 m (703 ft) on the south side and 166 m (545 ft) on the north side of useful berthing in 11.9 m (39 ft) deep waters. The pier has a mobile crane that can off-load spent fuel casks directly onto trucks or trains parked on the pier.

Pier Charlie, located about 1000 m (3281 ft) south of Pier Bravo, has been used for berthing nuclear submarines and a tender. It is not in regular use, but is maintained as a backup for Wharf Alpha and Pier Bravo. A portable crane, which is capable under ideal conditions of lifting 36,280 kg (40 tons), can be moved to Pier Charlie and used to off-load casks onto trucks. The Military Traffic Management Command dock is located about 3 km (9840 ft) down the river from Pier Charlie. This facility is in regular use for roll on/roll off military cargo. The Military Traffic Management Command dock is a safe distance from any weapons handling operations at Wharf Alpha or Pier Bravo. However, the same portable crane that could be used at Pier Charlie would be used at the Military Traffic Management Command dock.

The portable cranes available on the NWS Charleston may not be able to off load some larger casks, especially if they have to extend horizontally over the ship. The DOE and the NWS Charleston would plan to use shipboard cranes or rented cranes, or schedule these certain shipments to dock at Wharf Alpha or Pier Bravo. Commercial 82 metric ton (90 ton) and 118 metric ton (130 ton) cranes are available in the greater Charleston, SC area (Silver, 1995). Additionally, Pier Charlie and the Military Traffic Management Command dock are not directly served by rail. However, several rail heads on the NWS are in secure and isolated locations that can be used to load the fuel from trucks to trains.

The NWS Charleston is a fenced facility with several guarded gates and a 24 hour security force. Additional guard facilities and temporary barricades are used to keep unnecessary personnel away from ammunition handling, and could be used for this program. The on-base emergency facilities are appropriate for fire and rescue response to ammunition handling and other potential accidents. Additionally, the Propulsion Training Facility includes two operating nuclear reactors. The staff is adequately trained and equipped to make initial response and assessment of any accident with the potential for radioactive release or radiation exposure.

The NWS Charleston facility is capable of supporting the implementation of a policy to accept foreign research reactor spent nuclear fuel. The facility is experienced in handling nuclear and hazardous cargo, can be safely reached from open ocean, has adequate facilities, ready access to truck and rail transportation, and low human populations. Desirable attributes include excellent emergency response capabilities, acceptable environmental concerns, moderate concerns from severe natural phenomena, separation from urban population, no local restrictions and secure short term storage. The risk associated with the conflicting uses can be mitigated by rigorous compliance with Naval operation procedures.

The 1990 population within 16 km (10 mi) of the Wharf Alpha was 209,188. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: Savannah River Site, 46,200; Oak Ridge Reservation, 108,000; Idaho National Engineering Laboratory, 498,000; Hanford Site, 550,000; and Nevada Test Site, 540,000. Populations along rail routes to these sites are slightly larger. The distances to the five potential sites on interstate routes are: Savannah River Site, 301 km (188 mi); Oak Ridge Reservation, 644 km (402 mi); Idaho National Engineering Laboratory, 3,910 km (2,441 mi); Hanford Site, 4,580 km (2,858 mi); and Nevada Test Site, 3,930 km (2,543 mi). Distances along rail routes are slightly longer.

D.2.1.1.2 Wando Terminal

The South Carolina State Port Authority Wando Terminal is an ultra modern marine facility that is the designated hazardous materials terminal for the port ("Facility of Particular Hazard"), and is a superior terminal for receipt of spent nuclear fuel. In addition to being outside the city limits of Charleston and not subject to any potential restrictions on receipt and handling of spent nuclear fuel, it is closest to the Atlantic Ocean, and has outstanding facilities. The terminal has 3 container berths and 67.7 ha (167 acres) of paved container storage yard. It has a 428 m (1,400 ft) by 427 m (1,400 ft) turning basin. It currently has 740 m (2,430 ft) of lineal berthing space, but a fourth berth and 35.2 ha (87 acres) of additional paved storage area is currently under construction. The terminal is 8.1 km (5 mi) from the Mark Clark Expressway (I-526), which by-passes most of the city of Charleston and joins Interstate 26 at North Charleston. Of the four terminals in the Port of Charleston, Wando is the only one without direct rail service, requiring trucking of containers about 15 km (9 mi) to intermodal rail yards serviced by the CSX and Norfolk Southern Railroads. This was not considered a serious problem, since most shipments are anticipated to be carried overland by trucks.

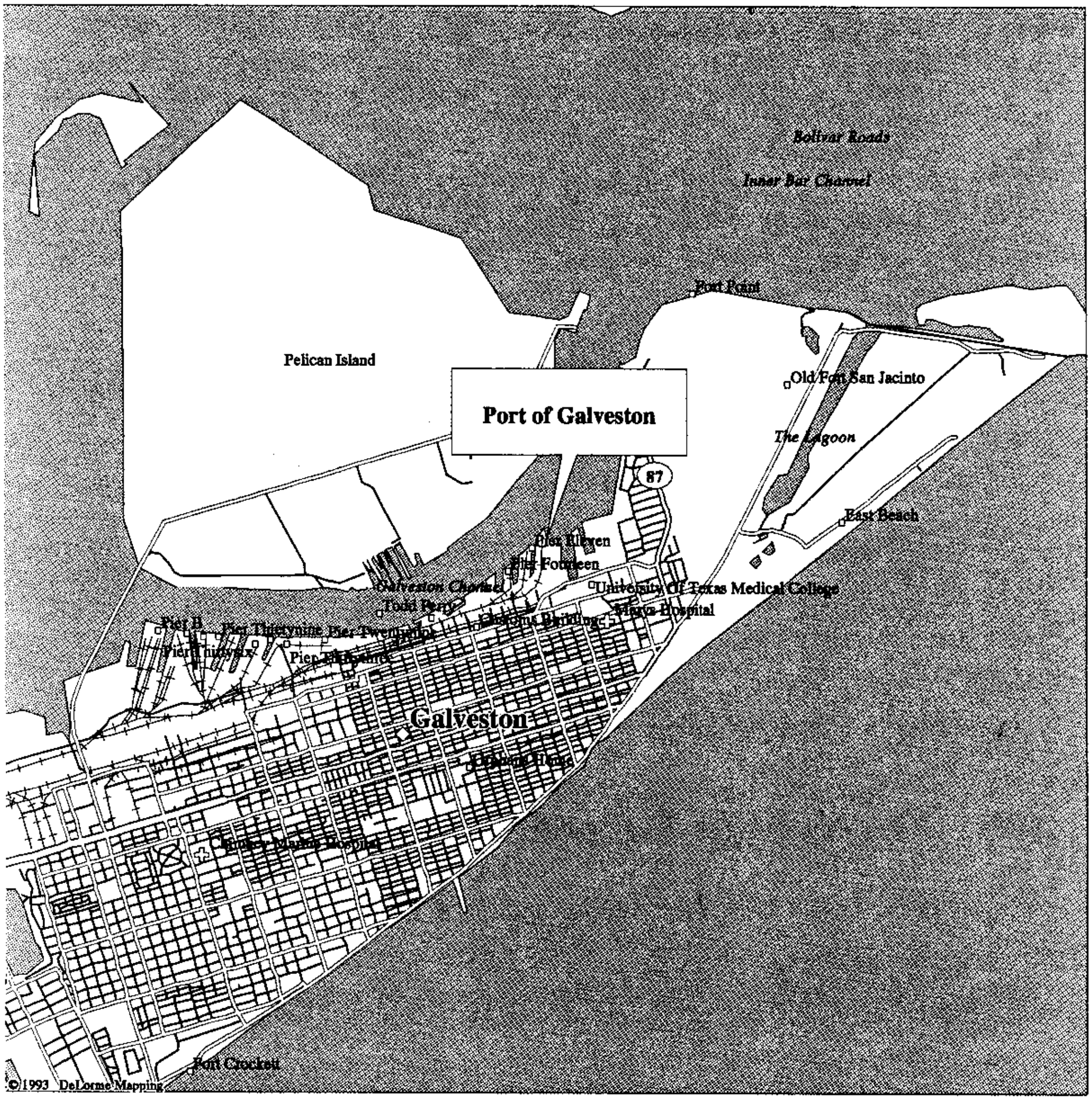
The 1990 population within 16 km (10 mi) of the Wando Terminal was 233,434. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: Savannah River Site, 65,700; Oak Ridge Reservation, 127,000; Idaho National Engineering Laboratory, 518,000; Hanford Site, 569,000; and Nevada Test Site, 559,000. Populations along rail routes to these sites are slightly larger. The distances to the five potential sites on interstate routes are: Savannah River Site, 325 km (203 mi); Oak Ridge Reservation, 668 km (417 mi); Idaho National Engineering Laboratory, 3,935 km (2,456 mi); Hanford Site, 4,600 km (2,873 mi); and Nevada Test Site, 4,098 km (2,558 mi). Distances along rail routes are slightly longer.

D.2.1.2 Galveston, TX

The Port of Galveston is about 16 km (10 mi) from the Gulf of Mexico via the Galveston channel. The City of Galveston, TX, occupies the entire width of the east end of Galveston Island. The shipping wharves are on the north side of the island and the Gulf of Mexico is on the south. The Port of Galveston is located in the heart of the City (DOC, 1992a). A map of the port is shown in Figure D-21.

As stated in the Coast Pilot, the Port of Galveston offers a short route to the sea and, together with the deep and easily navigated channel and excellent port facilities, enables Galveston to handle cargo most expeditiously and economically (DOC, 1992a). A Federal project provides for an entrance channel and an outer bar channel both dredged to 12.8 m (42 ft), thence 12.2 m (40 ft) to Galveston. The Port of Galveston is a multi-terminal port complex located on the northeastern end of Galveston Island, only 15 km (9.3 mi) from the entrance buoy to the open sea. Overall tonnage reported for 1991 was 4,159,233 metric tons (4,584,723 tons), of which approximately 17 percent (703,511 metric tons or 773,862 tons) was containerized freight (over 70,000 20-ft equivalent units). Roughly 77 percent of the tonnage was dry and liquid bulk, much of it grain (AAPA, 1993).

The Port of Galveston is a separate utility of the City of Galveston with its powers established by the City Charter. The Charter provides that all city-owned wharf and terminal properties be set aside and controlled, maintained, and operated by a "Board of Trustees of the Galveston Wharves."



LEGEND

- Population Center
- State Route
- Geo Feature
- Large City
- Street, Road
- Major Street/Road
- State Route
- Railroad
- River
- Open Water

Scale 1:50,000 (at center)

5000 Feet

1000 Meters

Mag 13.00
Mon Mar 27 08:46:03 1995

"Map(s) from MapExpert, DeLorme Mapping, Freeport, ME."

Figure D-21 Map of the Port of Galveston, TX

Principal container lines and the areas they serve include: Lykes Brothers — North Europe, Mediterranean, Mexico and West Coast of South America; Deppe Line — North Europe; Companhia Maritima Nacional — Brazil/Mexico; Compania Chilean Navegacion Interoceanica — South America/Mexico, and Del Monte/Network Shipping — Guatemala/Mexico (Jane's, 1992; AAPA, 1993).

Pier 10 Container Terminal: This is Galveston's principal container handling facility. It is leased to a private operator, Container Terminal of Galveston, Inc., who operates the facility as a public terminal. This facility has two berths, four container cranes, and 19.83 ha (49 acres) of paved storage area. The Port of Galveston owns an additional ten (10) open-dock ship berths and 20 berths with shipside warehouses used for breakbulk and other cargoes. The Container Terminal of Galveston, Inc. has two berths with a total length of 410 m (1,346 ft). Depth alongside the Container Terminal of Galveston, Inc. at mean low water is 12.2 m (40 ft). Crane capacities on Container Terminal of Galveston, Inc's. Pier 10 are three 50.8 metric tons (56 ton) container cranes and one 61.0 metric tons (67 ton) container crane. All cranes are equipped with 40.6 metric tons (45 ton) capacity spreaders.

The Container Terminal of Galveston, Inc. has a controlled all-weather truck entrance and interchange area. The terminal is connected to Interstate Highway 45 on the mainland by the 9.3 km (5.8 mi), four-lane State Highway 87 and two 2.8 km (1.75 mi) causeways that cross the southwest end of Galveston Bay. The island portion of the limited access route is through densely populated built-up areas. The Container Terminal of Galveston, Inc. is served by four major railroads: the Burlington Northern, Santa Fe, Southern Pacific, and Union Pacific Lines. Galveston Railway, Inc., provides terminal connections and performs switching of all rail traffic. An intermodal container transfer terminal is located within the container terminal and trackage extends to within 30.5 m (100 ft) of ship berths (Jane's, 1992; AAPA, 1993; Schultz, 1993).

Other Pertinent Information: The Port of Galveston has its own security force that provides 24-hour surveillance of its terminals. Container Terminal of Galveston, Inc. is fenced and has controlled access. An area is provided for segregation and temporary storage of hazardous cargoes.

The Port of Galveston's Director of Operations was unaware of any regulations prohibiting the importation of spent nuclear fuel (Schultz, 1993). The port occasionally handles hazardous materials, including Class A explosives (Schultz, 1993). NRC records indicate the port has not handled foreign research reactor spent nuclear fuel since at least 1979 (NRC, 1993).

The container terminal operator is responsible for handling hazardous materials emergencies at the Container Terminal of Galveston, Inc. facility. The Port of Galveston relies on the Galveston Fire Department's hazardous materials team and/or highly trained hazardous materials personnel at refineries located some 16-24 km (10-15 mi) away. The West Gulf Employers Association holds training courses for longshoremen which Port of Galveston terminal personnel also attend (Schultz, 1993).

Galveston is a major resort and tourist center for the Southwest United States. There is a 2.95 ha (7.3 acres) waterfront tourist attraction at "Pier 21" close to the historic district. A hospital is located across the street from the general cargo berths (Schultz, 1993). A public park on Pelican Island, reached by causeway, is located across the Intracoastal Waterway from the port. A cruise ship terminal is located at Pier 25 in the heart of the port complex and there is a tanker terminal on Pelican Island across from the port at its southern end. The greatest source of potential conflict is the heavy tanker traffic utilizing the Galveston entrance channel en route to Texas City and the Port of Houston petroleum/petrochemical terminals. Houston is the third most active port in the United States in terms of tonnage handled

(IPA, 1993). The U.S. Coast Guard accident data for the period 1991-1993 indicate 52 reported accidents in the Galveston Bay area (USCG, 1994b). This includes ship traffic bound for the Houston area and also includes barge accident data.

Other than general heightened environmental awareness, there are no known sensitive environmental areas in the Port of Galveston area (Schultz, 1993). The port is subject to hurricane and tropical storms. The likelihood of severe natural phenomena such as high winds and earthquakes is reflected in the structural requirements for buildings in each area of the United States. These are shown in the Uniform Building Code (UBC, 1991). For the Port of Galveston, the Uniform Building Code requires buildings to withstand wind speeds up to 160 km/hr (100 mph). The port is located in a very low seismic zone with an acceleration of less than 0.075 g.

The 1990 census population within 16 km (10 mi) of the port terminals was 73,322. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: Savannah River Site, 403,000; Oak Ridge Reservation, 337,000; Idaho National Engineering Laboratory, 526,000; Hanford Site, 575,000; and Nevada Test Site, 595,000. Populations along rail routes to these sites are slightly larger for Savannah River Site and Oak Ridge Reservation, but are slightly less for Idaho National Engineering Laboratory, Hanford Site, and Nevada Test Site. These populations are shown in Figures D-8 through D-17 in Section D.1. The distances to the five potential sites on interstate routes are: Savannah River Site, 1,600 km (1,000 mi); Oak Ridge Reservation, 1,550 km (963 mi); Idaho National Engineering Laboratory, 3,070 km (1,911 mi); Hanford Site, 3,740 km (2,327 mi); and Nevada Test Site, 3,000 km (1,862 mi). Distances along rail routes are slightly longer.

Environmental Conditions

A large number of aquatic and terrestrial species frequent the Galveston Bay area. A variety of birds migrate, winter, and breed along the Texas Coast including shorebirds, songbirds, waterfowl, and raptors (Breslin, 1993; FWS, 1992). These endangered/threatened bird species include the brown pelican, peregrine falcon, bald eagle, Attwater's greater prairie-chicken, piping plover, and the eskimo curlew (State-threatened only). Endangered/threatened marine mammals and sea turtles also are found in the coastal bay systems and the Gulf of Mexico. Galveston Bay is within the range of the green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles. While no protected species are known to be located within the Port of Galveston, significant populations of the endangered brown pelican and the piping plover exist nearby (Werner, 1994). The U.S. Fish and Wildlife Service reported that as many as 600 brown pelicans have been sighted loafing on the north end of Little Pelican Island, which is approximately 5.6 km (3.5 mi) northwest of the port. In addition, approximately 125 pairs nested and produced 90 young for the year at this site in 1994, the first time that brown pelicans had successfully nested in Galveston Bay in over 40 years. Wintering populations of the threatened piping plover use the northeastern end of Galveston Island and the southeastern end of Bolivar Peninsula. Of the 3,187 birds observed during the first Gulf Coast count of wintering piping plovers, 1,904 were observed on the Texas coastline (Werner, 1994).

A great amount of commercial and recreational fishing occurs in Galveston Bay and the Gulf of Mexico. Shellfish are the most important commercial species, particularly shrimp, followed by eastern oysters and blue crabs (TPWD, 1989a). The most valuable finfish landed from the Galveston Bay system are black drum, and mullet. In 1988, a total of 5,077,170 kg (11,169,773 lbs) of shellfish valued at $13,489,146 was landed from the Galveston Bay System; a total of 224,536 kg (493,980 lbs) of finfish valued at $226,140 was also landed. The major recreational species of fish that were caught in the Galveston Bay system in 1987-1988 were: Atlantic croaker, sand seatrout, spotted seatrout, southern flounder, black drum, and red drum (TPWD, 1989b).

While the port area is highly developed, a wide variety of marine, estuarine, and lacustrine wetlands exist along Galveston Bay, including a large portion of Pelican Island, directly west of the port. Wetlands also occupy the majority of the far northern end of Galveston Island (FWS, n.d.a.).

Climatic Conditions

The City of Galveston is bounded on the southeast by the Gulf of Mexico and on the northwest by Galveston Bay. Thus, the climate of the Galveston area is predominantly marine, with periods of modified continental influence during the colder winter months when cold fronts from the northwest sometimes reach the Texas coast. Because of its coastal location, sub-freezing temperatures are rare, and higher than normal humidities prevail throughout the year. Summer rainfall is highly variable across the island due to thunderstorms and the local sea breeze circulation. Winter precipitation comes mainly from frontal activity and onshore flow, which produces slow, steady rains under a low stratus cloud deck. The island has been subject at infrequent intervals to major tropical storm systems with hurricane-force winds (NOAA, 1993c).

D.2.1.3 Hampton Roads, VA (Includes the Combined Terminals at Newport News, VA; Norfolk, VA; and Portsmouth, VA)

Hampton Roads is one of the world's foremost bulk cargo harbors. It is a multi-terminal port with privately and publicly owned marine cargo handling facilities located at the southwest corner of the Chesapeake Bay at the confluence of the James and the Elizabeth Rivers. The port is about 26 km (16 mi) from the Virginia Capes and the entrance from the Atlantic Ocean. The major terminals located on the Elizabeth and James Rivers are approximately another 10 to 13 km (6 to 8 mi) from the Bay (DOC, 1993c). The port includes the ports and cities of Norfolk, Portsmouth, and Newport News. Adjacent communities include the cities of Chesapeake and Virginia Beach. The maps of the port are shown in Figures D-22 (Newport News), D-23 (Norfolk), and D-24 (Portsmouth).

In 1992, Hampton Roads handled approximately 5.9 million metric tons (6.5 million tons) and 875,000 20-ft equivalent units of containerized cargo, including large amounts of radioactive materials (primarily uranium dioxide). The port ranks closely with the port of Charleston as the second or third most active container port for the East and Gulf Coasts (DOE, 1994d). The port is serviced by more than 75 ship lines that serve the port on a regular basis and provide approximately 4,000 sailings a year to many countries of the world, including Scandinavia, Europe, the Mediterranean, Near East, Mideast, Far East, Africa, Japan, and South America. A partial listing of lines include Alianca, American-Africa-Europe, American Transport, Argentine Line-ELMA, ACL, Atlantic Express, Bank, Ceylon Shipping, CGM, Chilean Line, Cho Yang Shipping, COSCO, DB Turkish Cargo Lines, Deppe, DSR Senator, Eimskip, Evergreen, Farrell, Hapag-Lloyd, Hoegh, Italian Line, Ivarian Lines, Jugolinja, K Line, Lloyd Basilero, Lykes Lines, Maersk, Mediterranean Shipping, Mitsui OSK, NSCSA, Nedlloyd, Neptune Orient, Netumar Lines, NYK, OOCL, Ocean Star Container Line, P & O, PT Djakarta Lloyd, Safbank Lines, Sea-Land Service, Shipping Corp. of India, Spanish Line, Tokai Shipping, Toko Kaiu Kaisha Ltd., Torm West Africa, United Arab Shipping, Venezuelan Line Walleniuis, Waterman, Wilhelmsen, Yang Ming Line, and Zim (Jane's, 1992; AAPA, 1993).

Because Hampton Roads and its approaches from the Virginia Capes handle a large amount of shipping, traffic separation schemes have been established for the control of maritime traffic. The controlling depth in the Deep Water Route from the Virginia Capes is 15.2 m (50 ft), except for one 14.3 m (47 ft) location. Projected depth for the Hampton Roads channel varies from 15.2 m to 16.7 m (50 to 55 ft). Depth alongside terminals at Newport News and Portsmouth is about 11.6 m (38 ft), while at the Norfolk terminal it is 12.5 m (41 ft) (DOC, 1993c; Jane's, 1992).

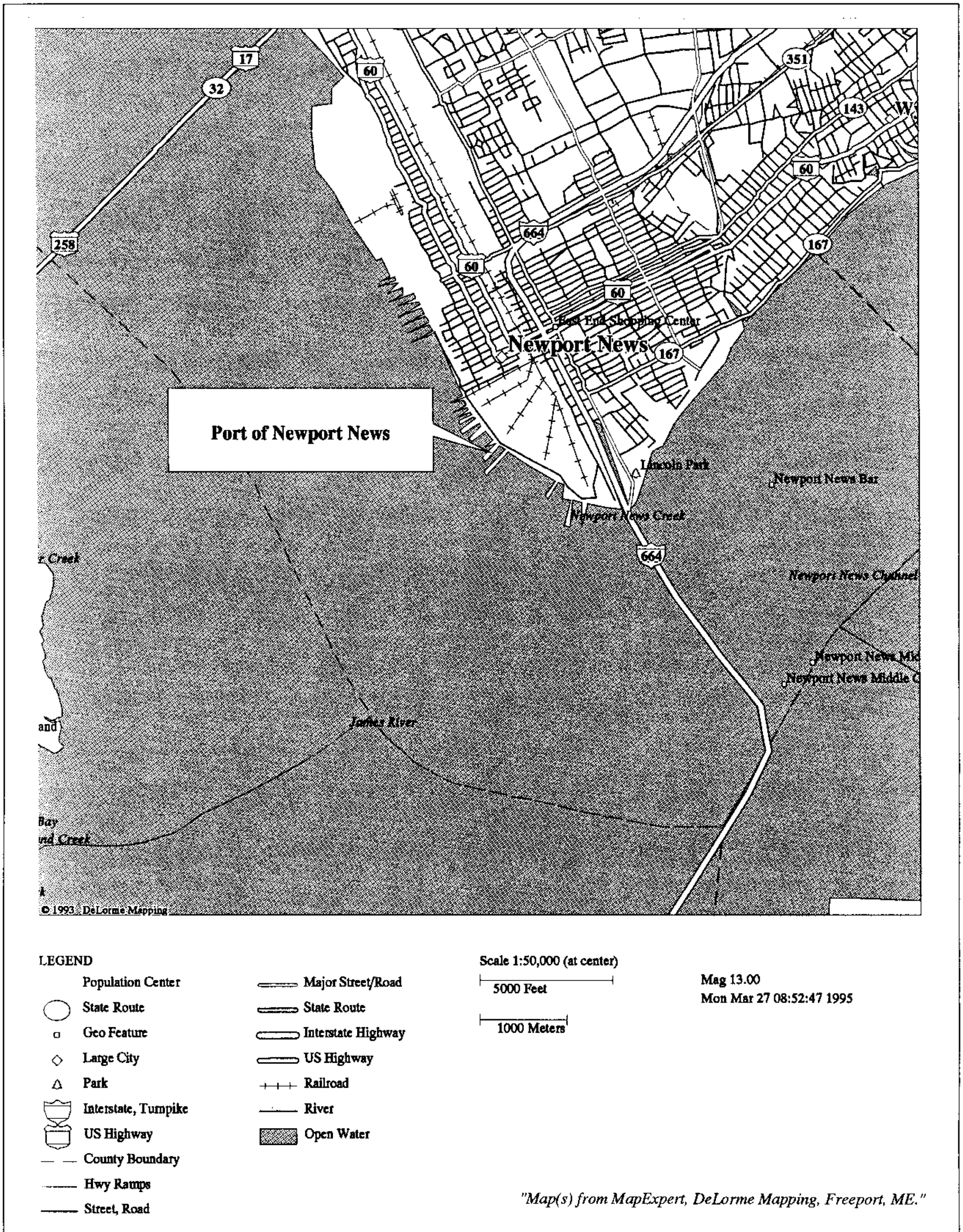


Figure D-22 Map of the Port of Newport News, VA

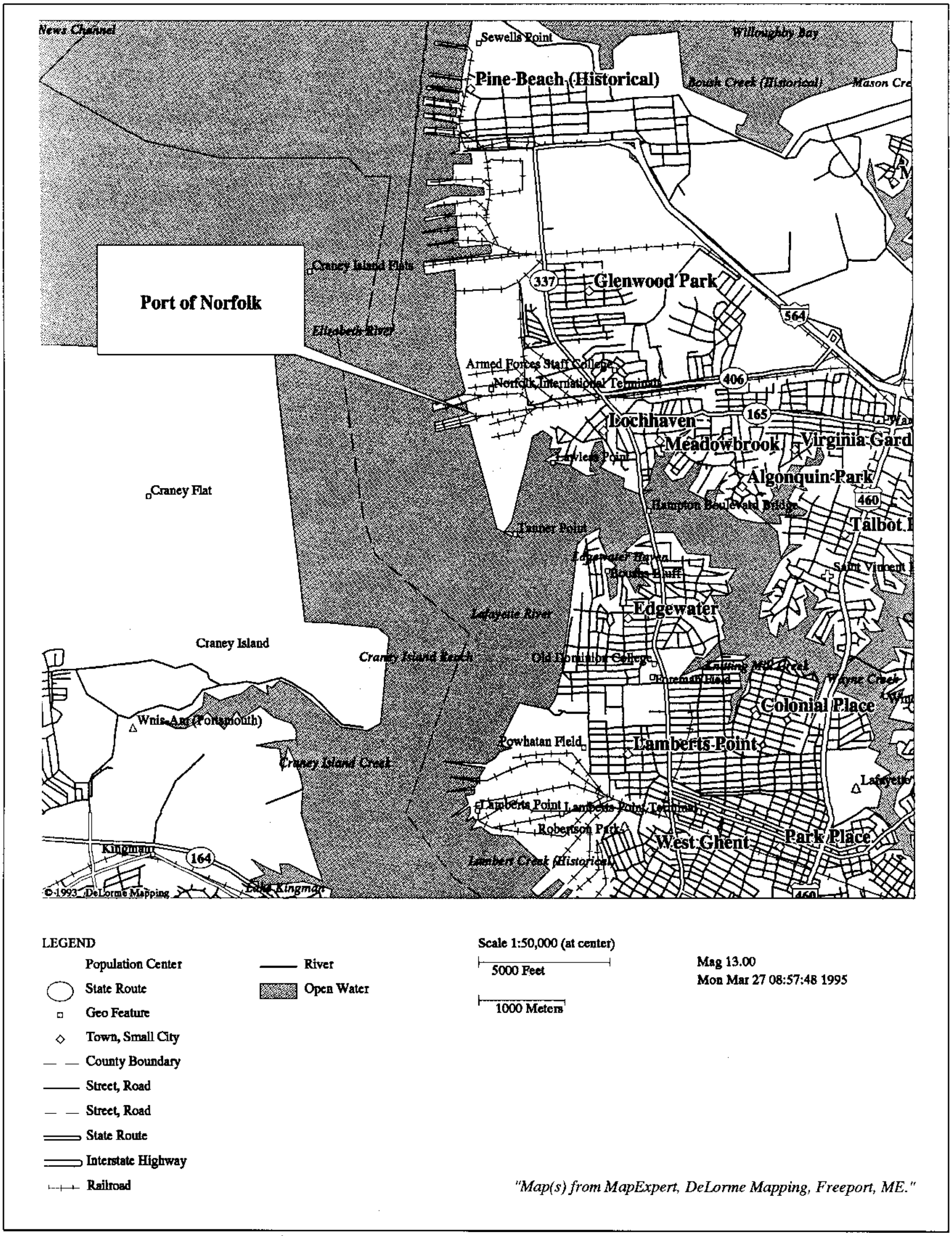


Figure D-23 Map of the Port of Norfolk, VA

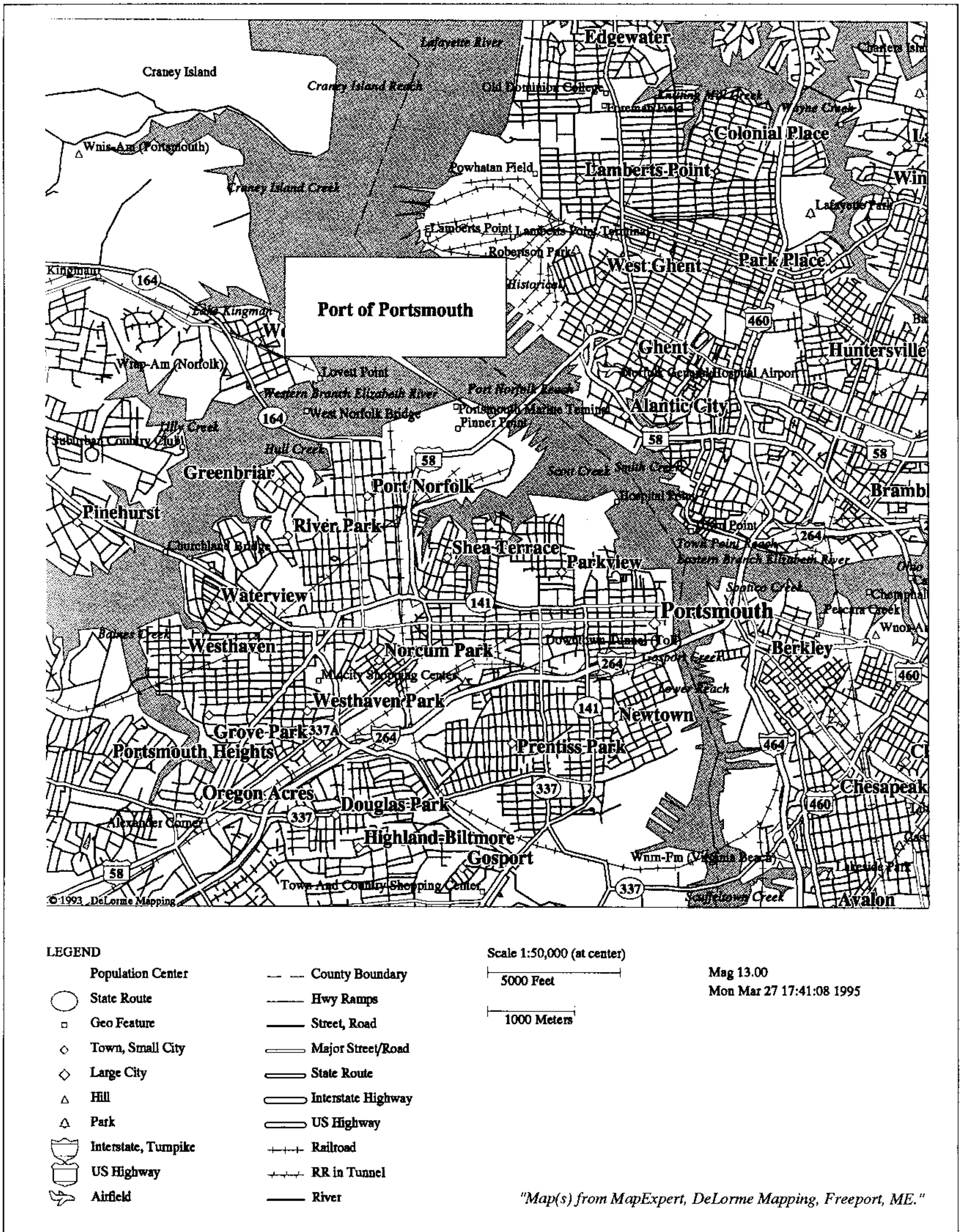


Figure D-24 Map of the Port of Portsmouth, VA

Changing weather can also be a concern as noted in the U.S. Coast Pilot: "Weather deterioration in the lower bay is often sudden and violent and constitutes an extreme hazard to vessels operating or anchoring in this area. The proximity of the bridge-tunnel complex to main shipping channels adds to the danger. Currents in excess of 1.5 meters-per-sec (3 knots) can be expected in this area" (DOC, 1993c).

The presence of three major vehicle tunnels (Chesapeake Bay tunnels, and Hampton Roads Tunnel with associated bridges) under the shipping channels are also sources of risk from ship collisions, especially in fog or during bad weather. Overall, however, the transit is direct and well-managed (DOC, 1993c).

The terminals of primary interest are owned by the Virginia Port Authority, that is a state agency reporting to the Secretary of Economic Development. The Virginia Port Authority's three large, general cargo terminals within the Greater Hampton Roads harbor area include Norfolk International Terminals which is a large container port that includes Sewell's Point Docks (a breakbulk facility), Portsmouth Marine Terminal, and Newport News Marine Terminals. These Terminals are operated by the Virginia International Terminals (the operating arm of the Virginia Port Authority). Lambert's Point Docks, a large breakbulk terminal owned by Norfolk Southern Railroad is also located on the Norfolk waterfront, but lacks container cranes. All three terminals are located in commercial port districts of their respective cities, somewhat separated from other community activities, in areas dedicated primarily to port industrial usage. The three Virginia Port Authority terminals are discussed below in subsections by terminal (Jane's, 1992; AAPA, 1993; FHI, 1994b; DOE, 1994d; VPA, 1994).

Other Pertinent Information: There are no regulatory restrictions prohibiting the receipt and handling of spent nuclear fuel in the port. Compliance with hazardous materials regulations (49 CFR) is the primary requirement. The Portsmouth Marine Terminal has had extensive experience in the receipt and handling of spent nuclear fuel shipments in the recent past, and Norfolk International Terminal and Newport News Marine Terminal also have had some experience (SNL, 1994; NRC, 1993). There appears to be little or no conflict with other hazardous cargoes, including petroleum products, naval weapons depots, etc., in the immediate vicinity of the three Virginia Port Authority terminals. The Virginia Port Authority depends on the Hampton Roads Emergency Team for response to hazardous materials accidents within its terminals. Hampton Roads Emergency Team consists of the fire departments of Norfolk, Portsmouth, and Virginia Beach, in liaison with the U.S. Coast Guard. Chief White of the Portsmouth Fire Department is in charge of the team, which also has ties to the State Emergency Team. All of the Virginia Port Authority terminal operating personnel and longshoremen are currently trained in hazardous materials awareness. Security for the port is provided by perimeter fences and the Virginia Port Authority's Port Police, which maintain 24-hour patrol and surveillance at all three terminals. The state of Virginia's Safety Manual sets forth the rules and policies for operations, including, among other things, hazardous cargoes, container control, emergency procedures and general safety, and provides the policy for receipt and handling of radioactive materials, including emergency response, personnel protection, facility protection, environmental protection and cargo protection (Edwards and Drews, 1993).

All three terminals are located in a large urban area in which congestion is to be expected. Of the three terminals, Portsmouth Marine Terminal is located closest to residential and downtown areas; however, Portsmouth is a relatively small city in both area and population, and it is only a short distance from the terminal to more sparsely populated rural areas. Conversely, truck shipments from Norfolk International Terminals, the terminals closest to the sea, must travel about 38 km (24 mi) of heavily trafficked Interstate through built-up sections of Norfolk, Virginia Beach, and Chesapeake before reaching Bowers Hill (a rural area). The comparable distance from Portsmouth is about 6 km (4 mi).

The likelihood of severe natural phenomena such as high winds and earthquakes is reflected in the structural requirements for buildings in each area of the United States. These are shown in the Uniform Building Code (UBC, 1991). For the Port of Hampton Roads, the Uniform Building Code requires buildings to withstand wind speeds up to 140 km/hr (90 mph). The port is located in a low seismic zone with an acceleration of 0.075 g.

Environmental Conditions

The lower Chesapeake Bay - Hampton Roads area is located on the coastal plain of southeastern Virginia. This area is rather flat and is dissected by numerous bays, rivers, creeks, and wetlands including saltwater marshes, bogs, and swamps (DOE, 1995). However, the areas in the vicinity of the Ports of Newport News, Norfolk, and Portsmouth are highly developed and the waterfronts consist largely of piers and bulkheads associated with the various shipyards, shipping terminals, warehouses and railroad yards that comprise this heavily utilized harbor area. The U.S. Fish and Wildlife Service reports that there are no Federally-listed or proposed listing for endangered or threatened species within a one-mile radius of the Portsmouth or Newport News Terminals (Mayne, 1994). However, rare, threatened, and endangered plant and animal species may be found around the cities of Newport News, Norfolk, and Portsmouth (O'Connell, 1994).

The waters of the Chesapeake Bay and Hampton Roads can be classified as a high-salinity estuarine habitat (generally 16.5-30 parts per thousand), while the Elizabeth and James Rivers, in the vicinity of the ports addressed in this section, are classified as mid-salinity estuarine habitat (generally 5-16.5 ppt) (FWS, 1980d). A number of aquatic species can generally be found in mid-salinity estuarine habitat in this area. Of particular note is the Atlantic sturgeon, a state-endangered species that migrates through these areas. In addition, the eastern oyster is common in the Elizabeth River, in the vicinity of the Norfolk International Terminal and the Portsmouth Marine Terminal. Blue crabs, eastern oysters, and hard clams are also found in the vicinity of the Newport News Marine Terminal (FWS, 1980d). However, Hampton Roads, the Elizabeth River, and portions of the James River (including that portion along the port of Newport News) have been designated as the "Condemned Shellfish Area No. 7" by the Virginia State Department of Health (West, 1994). Shellfishing is either restricted (special permits) or prohibited in this area. The State of Virginia also reports that a fishing health advisory is in effect for the James River and its tributaries due to Kepone contamination. In addition, the Southern Branch of the Elizabeth River, which is upstream of the Norfolk International and Portsmouth Marine Terminals, only partially supports water column standards for dissolved oxygen and sediment standards for lead. The waters in the Hampton Roads area are considered to be "swimmable" by the State of Virginia (West, 1994). The Tidewater area is part of the Mid-Atlantic flyway, and the numerous waterways and wetlands in this area are utilized by many migratory birds that pass through or winter in this region. There is generally a lack of suitable habitat or forage areas in the immediate vicinity of these ports. However, the Ragged Island Wildlife Management Area, located across the James River from the Port of Newport News, is used as a migratory area for waterfowl. Nesting areas for the great blue heron and the yellow-crowned night heron, both State-protected species, are reportedly located on the Lafayette River, approximately 3.2 km (2 mi) upstream of the Norfolk International Terminal (FWS, 1980d). More recently, the U.S. Fish and Wildlife Service indicated that a yellow-crowned night heron rookery consisting of eight nests was documented in the vicinity of the Norfolk Terminal (Mayne, 1994).

There are no known areas of special environmental concern other than the growing interest in preservation of the Chesapeake Bay and its tributary rivers. While the Dismal Swamp National Wildlife Refuge is located about 16 km (10 mi) from the two terminals on the Elizabeth River, the water drainage from the swamps is toward the port, and would not normally carry waterborne radioactivity into the swamp. Further, the swamp is far enough from the terminals so that any radiological impacts from airborne releases (e.g., fires) would be expected to be negligible. In port, any potential negative impacts of low-probability, severe accidents on wildlife populations would be limited to the immediate area around the terminals.

Climatic Conditions

The Port of Hampton Roads, VA is located at the confluence of the James River and the Chesapeake Bay, approximately 29 km (18 mi) west of the Atlantic Ocean. The average elevation of this region is approximately 4 m (13 ft) above sea level.

The geographic location of this region is especially favorable, tending to be located south of the predominant winter extratropical cyclone tracks which originate at higher latitudes and north of the usual tropical cyclone (e.g., tropical storms and hurricanes) paths. In general, the winters are mild with slightly warmer temperatures during the spring and fall seasons. The summer season is warm and long, but is characterized by frequent cool periods, generated by cool northeasterly winds off of the North Atlantic. Extreme cold waves are infrequent, and temperatures below 18°C (0°F) are almost nonexistent. In general, winters pass without measurable snowfall, and most snowfall melts within 24 hrs. The average first sub-freezing day in the fall is November 17 and the last occurrence in the spring is March 23. The predominant wind directions since 1984 are from the south-southwest (about 30 percent) and north-northeast (about 25 percent) and vary seasonally (NOAA, 1992a).

D.2.1.3.1 Newport News Marine Terminal

This terminal is located on the north shore of the Port of Hampton Roads on the James River. It is a combination container, roll-on/roll-off, and breakbulk terminal. The facility has two piers (B and C), a total area of 56.9 ha (141 acres), five berths [two container berths, (each 284 m (930 ft) long), three breakbulk berths (totaling 667 m or 2,190 ft)], and four container cranes [(two 40.6 metric ton (45 ton) and two 30.5 metric ton (33.6 ton)]. Pier B is 189 m (620 ft) long and 168 m (550 ft) wide with three ship berths. Pier C is 285 m (985 ft) long and 165 m (540 ft) wide with equal dimensions of both the north and south sides. There is covered storage on both piers (36,620 m^2, or 394,200 ft^2) and the container handling terminal has storage for 790 stacked containers and 1,210 containers on chassis. The Virginia Port Authority is improving this terminal with a new 9,300 m^2 (100,000 ft^2) warehouse (Jane's, 1992; AAPA, 1993; FHI, 1994b).

Newport News Marine Terminal has immediate access to Interstate-664 outside the terminal. I-664 connects with I-64 Northbound, bypassing the Hampton Roads Tunnel, en route to the Richmond bypass, I-295 South, which connects with I-95 and I-85 Southbound. The terminal is served shipside via CSX Railroad, with direct rail service (Jane's, 1992, FHI, 1994b; AAPA, 1993).

The 1990 population within 16 km (10 mi) of the port terminals was 430,757. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: Savannah River Site, 181,000; Oak Ridge Reservation, 209,000; Idaho National Engineering Laboratory, 628,000; Hanford Site, 677,000; and Nevada Test Site, 691,000. Populations along rail routes to these sites are slightly larger. These populations are shown in Figures D-8 through D-17 in Section D.1. The distances to the five potential sites on interstate routes are: Savannah River Site, 840 km (519 mi); Oak Ridge Reservation, 890 km (553 mi); Idaho National Engineering Laboratory, 4,010 km (2,492 mi); Hanford Site, 4,680 km (2,908 mi); and Nevada Test Site, 4,172 km (2,595 mi). Distances along rail routes are slightly longer.

D.2.1.3.2 Norfolk International Terminals

This is the Virginia Port Authority's largest container handling facility, located on the south side of the Port in Norfolk, adjacent to the Navy Base on the Elizabeth River Channel. The Norfolk International Terminals have a wharf area of 328 ha (811 acres), 4 container berths, 7 container cranes, room for stacking 23,930 20-ft equivalent units four high, chassis stackers for 702 chassis, a roll-on/roll-off berth and covered pier storage of 83,640 m^2 (900,000 ft^2) plus associated container terminal handling equipment. Sewell's Point Terminal, located at the north end (seaward) of the Norfolk International Terminals' container berths consists of 12.14 ha (30 acres) of land area, two piers, and covered storage for breakbulk cargoes. The Norfolk International Terminals have four container berths, 1,289 m (4,230 ft) in length, six 40.6 metric ton (45 ton) container cranes, and one 30.5 metric ton (33.6 ton) container crane.

The terminal is located approximately 2.9 km (1.8 mi) from Interstate 64 via International Terminal Boulevard (a multi-lane industrial roadway bordering the Norfolk Naval Base). It is assumed that travel on I-64 would be southbound only because of the Hampton Roads Tunnel on I-64 North. Southbound routing requires crossing several bridges over the Eastern and Southern Branches of the Elizabeth River and dealing with frequent traffic congestion on the heavily traveled Interstate. The Norfolk International Terminals is served directly (shipside) by the Norfolk Southern Railroad, and indirectly via the Norfolk and Portsmouth Belt Line Railroad, with CSX and Eastern Shore Railroads (AAPA, 1993; FHI, 1994b).

The 1990 population within 16 km (10 mi) of the port terminals was 681,864. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: Savannah River Site, 131,000; Oak Ridge Reservation, 174,000; Idaho National Engineering Laboratory, 631,000; Hanford Site, 694,000; and Nevada Test Site, 694,000. Populations along rail routes to these sites are slightly larger. These populations are shown in Figures D-8 through D-17 in Section D.1. The distances to the five potential sites on interstate routes are: Savannah River Site, 800 km (498 mi); Oak Ridge Reservation, 880 km (550 mi); Idaho National Engineering Laboratory, 4,070 km (2,530 mi); Hanford Site, 4,740 km (2,949 mi); and Nevada Test Site, 4,240 km (2,633 mi). Distances along rail routes are slightly longer.

D.2.1.3.3 Portsmouth Marine Terminals

This is the Virginia Port Authority's second largest marine container handling facility, located further upstream at the confluence of the Elizabeth River and its Western Branch in the City of Portsmouth. The terminal has 3 berths that handle container, breakbulk and roll-on/roll-off cargoes, and a total land area of 88.7 ha (219 acres). It has four marginal berths with a total length of 1,080 m (3,540 ft), with 759 m (2,490 ft) of container berths. The terminal has a storage capacity of 1,770 stacked containers and 2,000 containers on chassis. The terminal also has 14,900 m^2 (160,400 ft^2) of warehouse space. The terminal has three 30.5 metric ton (33.6 ton) container cranes, one 40.6 metric ton (45 ton) container crane, and one 48.8 metric ton (54 ton) container crane.

The Portsmouth Marine Terminals are located approximately 4 km (2.5 mi) from the entrance ramp to I-264, a beltway that links up with U.S. Route 58 westbound in the rural Bowers Hill area of Chesapeake en route to I-95 or I-85 south. The assumed route from the Portsmouth Marine Terminals to the Beltway would be via Harbor Drive and Turnpike Road (State Highway 337), which runs through an area of mixed, small businesses and low-density housing for about 1.6 km (1.0 mi). The Portsmouth Marine Terminals are served directly (shipside) by the CSX Railroad with connections to the other rail lines via the Norfolk and Portsmouth Belt Line Railroad (AAPA, 1993; FHI, 1994b).

The 1990 population within 16 km (10 mi) of the port terminals was 665,700. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: Savannah River Site, 135,000; Oak Ridge Reservation, 257,000; Idaho National Engineering Laboratory, 670,000; Hanford Site, 718,000; and Nevada Test Site, 732,000. Populations along rail routes to these sites are about the same for Eastern sites and slightly larger for Western sites. These populations are shown in Figures D-8 through D-17 in Section D.1. The distances to the five potential sites on interstate routes are: Savannah River Site, 810 km (501 mi); Oak Ridge Reservation, 780 km (487 mi); Idaho National Engineering Laboratory, 4,040 km (2,514 mi); Hanford Site, 4,710 km (2,930 mi); and Nevada Test Site, 4,210 km (2,617 mi). Distances along rail routes are slightly longer.

D.2.1.4 Jacksonville, FL

The Port of Jacksonville is located on the Atlantic Coast of Northern Florida, along the St. Johns River. It is a geographically large city (1,967 km^2 or 760 mi^2), ranging from the town of Orange on the east side of the river to Julington Creek on the west side. Most of the marine terminals are on the west side of the river, about 34 km (21 mi) from the ocean entrance. However, the Blount Island container terminal is well-separated from the city, and is only about 11 km (7 mi) from the harbor entrance. A Federal Project maintains a channel depth of 12.2 m (40 ft) to 12.8 m (42 ft) at the entrance to the river. The depth gradually decreases to about 9.1 m (30 ft) at the railroad bridge in Jacksonville. The Blount Island Terminal is located downstream from the railroad bridge in a deeper part of the channel (DOC, 1993d; Jane's, 1992; AAPA, 1993; Southern Shipper, 1993). A map of the port is shown in Figure D-25.

The St. Johns River has a deep, steep-sided channel cut through the rock in some areas. This channel configuration, combined with the increased size and draft of vessels entering the port makes the river difficult to navigate. Tidal currents in the river are strong as far as Jacksonville, approaching 1.5 meters-per-sec (3 knots) in several places (DOC, 1993d).

The Jacksonville Port Authority (Jaxport) operates two deep water container/general cargo terminals: Blount Island, located approximately 11 km (7 mi) from the harbor entrance and Talleyrand Docks and Terminals, located about 34 km (21 mi) from the entrance. Both terminals are equipped with modern entrance cranes, handle breakbulk and other types of cargo, and have transit sheds, warehouses, and open storage areas. Of the two, Blount Island is preferred because of its separation from the high density downtown area and closer proximity to the sea. A new terminal is under consideration adjacent Blount Island at Dames Point (Southern Shipper, 1993).

Both terminals serve a number of major general cargo and container ship lines from around the world including Sea-Land, NYK, Hyundai, and Mitsui OSK, that offer worldwide cargo services, and Columbus and Blue Star Line (Australia service). These lines provide service to many regions of the world, including Europe, the Mideast, South America, and Australia (Southern Shipper, 1993; Jane's, 1992).

Blount Island Terminal: Blount Island is a 356 ha (880 acre) facility with 1,920 m (6,299 ft) of berthing space, of which Berth 12 is the longest [351 m (1,150 ft)]. Blount Island Berths 7-13 have 11.6 m (38 ft) of water alongside at mean low water, and five 40.6 metric ton (45 ton) container cranes. It has 34,000 m^2 (360,000 ft^2) of transit sheds/warehousing and 149 ha (367 acres) of open storage. This terminal is connected to the mainland via a fixed highway bridge that joins State Highway 105 (Necksher Drive) and connects with I-95 and Route 17 about 8 km (5 mi) north of the City of Jacksonville. A new eight lane truck security plaza was dedicated in 1992. Blount Island has pierside service by the CSX Railroad that connects with the Norfolk Southern Railroad (Southern Shipper, 1993).

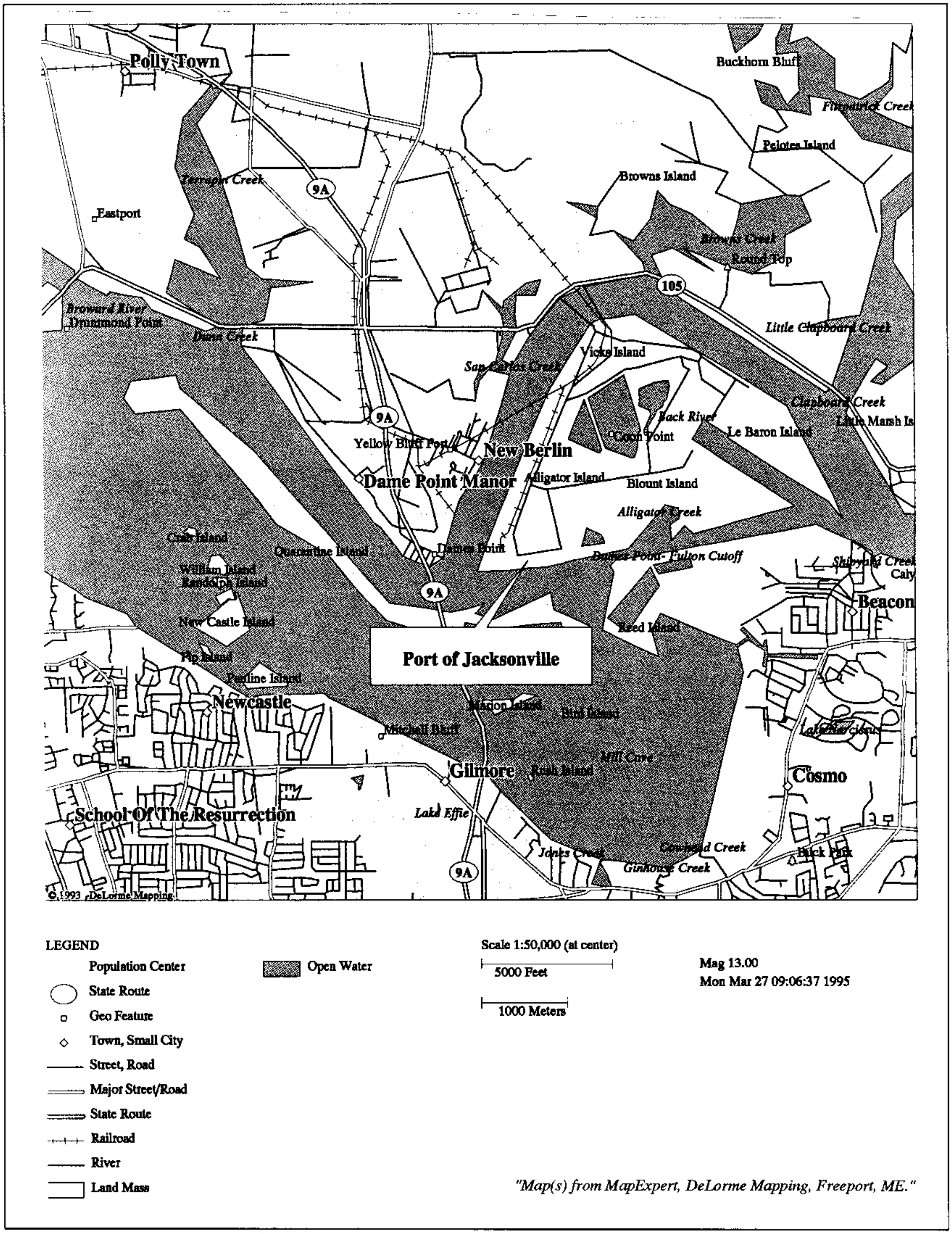


Figure D-25 Map of the Port of Jacksonville, FL

Talleyrand Terminal: Talleyrand Docks is a 70 ha (172 acre) facility with 1,250 m (4,100 ft) of marginal wharf on deep water [11.6 m (38 ft)] at mean low water. It has two 40.6 metric ton (45 ton) container cranes, and two large gantry whirley cranes [50.8 metric ton (56 ton) and 102 metric ton (112 ton)], and 14,900 m^2 (160,000 ft^2) of transit sheds/warehousing with 49 ha (120 acres) of paved open storage (fenced and lighted). Talleyrand Terminal is located in downtown Jacksonville's shopping and commercial zone, about 2.9 km (1.8 mi) downstream of the John R. Matthews Bridge (alternate U.S. Route 90), and less than 1 km (0.6 mi) via city streets to the Expressway (alternate U.S. Route 1) (Southern Shipper, 1993).

Other Pertinent Information: The Port Authority is not aware of any local regulatory restrictions on receipt and handling of spent nuclear fuel (Castiel, 1993). The terminals have no prior experience handling spent nuclear fuel (SNL, 1994; NRC, 1993) or hazardous wastes, but do handle hazardous cargoes such as poisons, corrosives, and Class B explosives. Jaxport is a member of Jacksonville Spillage Control and the City of Jacksonville's Hazardous Materials Team. Terminal operating personnel and longshoremen receive basic instruction in the handling of hazardous cargoes. Around the clock security is provided to both terminals by the Jacksonville Port Authority, with secure, short-term storage available if needed.

There are several tanker terminals and petroleum storage depots downstream and immediately adjacent Talleyrand Docks and Terminals. Blount Island Terminal appears to have no petroleum terminals or other conflicting cargo activities (Castiel, 1993).

While the entire State is environmentally aware, there are no known sensitive wildlife sanctuaries in the immediate area of Jaxport. Blount Island is surrounded by extensive marsh and wetlands. The port is subject to severe hurricanes and tropical storms. The likelihood of severe natural phenomena such as high winds and earthquakes is reflected in the structural requirements for buildings in each area of the United States. These are shown in the Uniform Building Code (UBC, 1991). For the Port of Jacksonville, the Uniform Building Code requires buildings to withstand wind speeds up to 160 km/hr (100 mph). The port is located in a very low seismic zone with an acceleration of less than 0.075 g.

The 1990 population within 16 km (10 mi) of the port terminals was 334,212. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: Savannah River Site, 46,900; Oak Ridge Reservation, 175,000; Idaho National Engineering Laboratory, 576,000; Hanford Site, 643,000; and Nevada Test Site, 639,000. Populations along rail routes to these sites are slightly larger. These populations are shown in Figures D-8 through D-17 in Section D.1. The distances to the five potential sites on interstate routes are: Savannah River Site, 607 km (377 mi); Oak Ridge Reservation, 912 km (567 mi); Idaho National Engineering Laboratory, 4,030 km (2,504 mi); Hanford Site, 4,700 km (2,924 mi); and Nevada Test Site, 4,190 km (2,607 mi). Distances along rail routes are about the same.

Environmental Conditions

The area between the mouth of the St. Johns River and Blount Island is characteristic of typical coastal lowlands found along the southeastern United States. Numerous creeks meander through large expanses of marshes and swamps. With the exception of the U.S. Naval Station Mayport and the village of Mayport, which occupy the first several kilometers along the southern bank of the river, the land bordering the lower portion of the river is largely undeveloped, with the exception of riverfront residences, mainly along the northern bank. In fact, most of the land to the north of the river between Blount Island and the coast is part of the Nassau River - St. Johns River Marshes Aquatic Preserve. The Fort Caroline National Memorial is located southeast of Blount Island on the southern bank of the river. The Little Talbot Island State Park is located approximately 1.6 km (1 mi) north of the channel entrance.

The lower 24.2 km (15 mi) of the St. Johns River has been designated as critical habitat for the manatee, a listed endangered species. The river is also used as a migratory area for the shortnose sturgeon, a listed endangered species (FWS, 1980e). According to the Florida Natural Areas Inventory, the following rare species have been reported within 3.2 km (2 mi) of the Blount Island Terminal: West Indian Manatee (State and Federal Listed Endangered Species), shortnose sturgeon (State and Federal Listed Endangered Species), Atlantic sturgeon (State Listed Species of Special Concern and Federal Listed Threatened Species), sea lamprey, and the opossum pipefish (Murray, 1994). In addition, the U.S. Fish and Wildlife Service reports that the following protected marine species may occur in Duval County: west indian manatee (endangered), shortnose sturgeon (endangered), Kemp's ridley sea turtle (endangered), leatherback sea turtle (endangered), loggerhead sea turtle (threatened), hawksbill sea turtle (endangered), and the green sea turtle (threatened). Protected bird species include the bald eagle (endangered), wood stork (endangered), piping plover (threatened), and red-cockaded woodpecker (endangered) (Bentzien, 1994).

A variety of wading birds are also found in the vicinity of the Fort Caroline National Memorial. Several species of birds, including shorebirds, waterfowl, and gannets frequent the area around the jetties at the channel entrance. In particular, the brown pelican (a State Species of Special Concern) is found in this area. A variety of birds inhabit the Little Talbot Island State Park, including the American oystercatcher (a State Species of Special Concern). Loggerhead sea turtles (a listed endangered species) use the beaches along this portion of Florida as a nesting area (FWS, 1980e).

Climatic Conditions

The Port of Jacksonville, FL, is located along the lower 39.4 km (24.5 mi) of the St. Johns River. The terrain in this area is relatively level, providing very little change in relief proceeding inland from the coastal region.

As with the other more northern ports, the climate of this area is also modified by the influence of the Atlantic Ocean. Easterly winds occur roughly 40 percent of the time, producing a true maritime climate for the Jacksonville area. The greatest rainfall occurs during summer, usually associated with afternoon and evening thunderstorms. During summer, measurable precipitation can be recorded nearly every two days. The prevailing winds are northeasterly in the fall and winter months, becoming more southwesterly during spring and summer. Although Jacksonville is along the eastern United States coast, it has been very fortunate in escaping hurricane-force winds. The majority of systems in recent years that have reached this latitude have moved parallel to the coastline, keeping well offshore. Others have weakened significantly moving over land prior to reaching the Jacksonville area. The combination of these two factors has spared the area from any major devastation due to tropical systems in recent years (NOAA, 1992e).

D.2.1.5 Military Ocean Terminal, Sunny Point, NC

The Military Ocean Terminal at Sunny Point (MOTSU) is a defense transportation facility used to move military cargo (principally munitions) into and out of the United States. The terminal is located approximately 16 km (10 mi) upstream from the mouth of the Cape Fear River on the Atlantic Coast near Southport, NC. A map of the port is shown in Figure D-26. The port is easily accessed from the ocean, and all commercial vessels bound for Wilmington, NC must pass by MOTSU. It is served by a 12.1 m (40 ft) deep by 152 m (500 ft) wide channel from the ocean (DOE, 1994d).

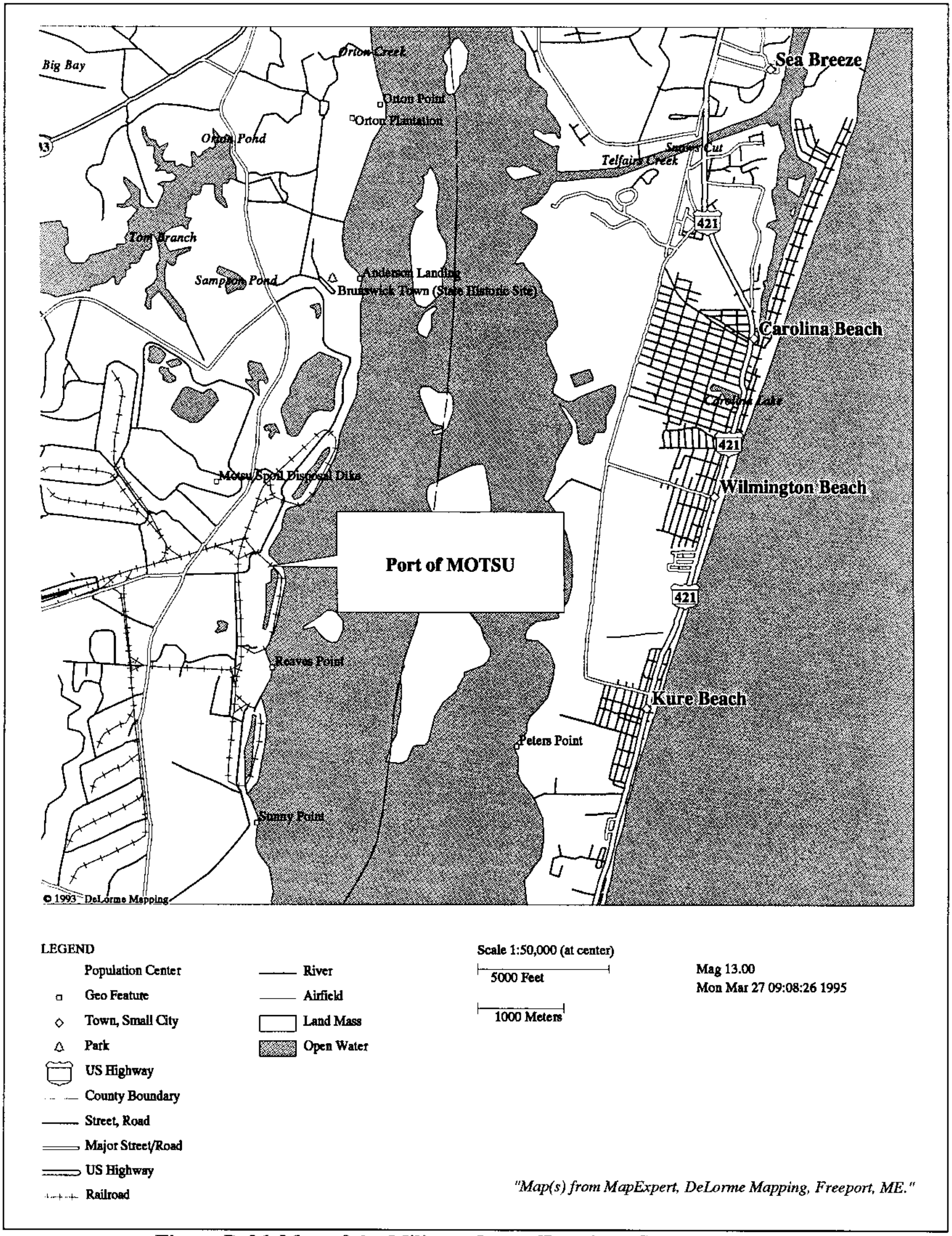


Figure D-26 Map of the Military Ocean Terminal, Sunny Point, NC

Since the majority of cargoes handled at MOTSU are explosive, the terminal is laid out such that an explosion at one wharf will not seriously impact activities at an adjacent wharf. This would permit containerized spent nuclear fuel carried in a commercial vessel (without explosive or hazardous cargoes on-board) to be safely received and transported from the terminal, even though there are conflicting activities within the terminal. Further, after many years of service, MOTSU has never had an explosion accident, so the risks are believed to be small. However, unloading of spent nuclear fuel would be scheduled during periods when explosives were not being unloaded. On average, MOTSU receives about 70 vessels per year, and moves approximately 433,000 metric tons (476,000 tons) of cargo through the port.

While regularly scheduled commercial container or breakbulk vessels do not call at MOTSU, commercial container vessels chartered by defense agencies routinely call at the port. The water depth (channel and alongside the wharves) of 10.3 m (34 ft) mean low water is adequate for most commercial breakbulk, roll-on/roll-off, and container ships. The terminal has three 606 m (2,000 ft) wharves, each with three berths. All wharves have three parallel sets of rail tracks. Berth 1, on the south wharf, has two 45.3 metric ton (50 ton) container cranes capable of off-loading container or container/breakbulk vessels. Berth 3 has been modified with a 30 m (100 ft) wide, reinforced concrete apron that permits breakbulk and roll-on/roll-off operations in addition to containerized cargoes (DOE, 1994d).

MOTSU is serviced by well-maintained roads which are primarily two-lane roads providing connections to multi-lane controlled access highways. In the event that MOTSU was utilized for receipt of foreign research reactor spent nuclear fuel, all transport of spent nuclear fuel over these roadways would be in conformance with State regulations for normal truck traffic between MOTSU and other locations to avoid overloading roadways and bridges. Truck access is provided by State Route 87 from the northwest and State Route 133 from the north. Route 87 provides access to U.S. 17, which runs southwest or northeast. The distance from the terminal gate to Route 133 is about 3.7 km (2.2 mi). Route 133 runs directly to U.S. 17 just outside Wilmington, NC. From Wilmington, U.S. 74 runs west 120 km (75 mi) to Interstate 95, the nearest major north-south highway (DOE, 1994d). A dedicated 157 km (97.4 mi) U.S. Army rail line connects the CSX network directly to the terminal.

Other Pertinent Information: At the present time, there are no regulatory restrictions on receipt, handling, and transhipment of foreign research reactor spent nuclear fuel at MOTSU. MOTSU is the only port in the contiguous United States which has current experience with foreign research reactor spent nuclear fuel receipt and handling, with two shipments received in October 1994 under the Urgent Relief Environmental Assessment.

Cargo handling at the terminal, including explosives, is performed by members of the International Longshoremen Association. Port security is maintained on land by security guards, and on water by dedicated patrol boats.

The likelihood of severe natural phenomena, such as high winds and earthquakes, is reflected in the structural requirements for buildings in each area of the United States. These are shown in the Uniform Building Code (UBC, 1991). For MOTSU, the Uniform Building Code requires buildings to withstand wind speeds up to 160 km/hr (100 mph). The port is located in a low seismic zone with an acceleration of 0.075 g.

The 1990 population within 16 km (10 mi) of the port terminals was 7,995. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: Savannah River Site, 34,200; Oak Ridge Reservation, 128,000; Idaho National Engineering Laboratory, 463,000; Hanford Site, 548,000; and Nevada Test Site, 619,000. Populations along rail routes to these sites are slightly larger. These populations are shown in Figures D-8 through D-17 in Section D.1. The distances to the five potential sites on interstate routes are: Savannah River Site, 402 km (250 mi); Oak Ridge Reservation, 798 km (496 mi); Idaho National Engineering Laboratory, 3,873 km (2,407 mi); Hanford Site, 4,615 km (2,868 mi); and Nevada Test Site, 3,953 km (2,457 mi). Distances along rail routes are slightly longer.

Climatic and environmental information for MOTSU is similar to that for the Port of Wilmington, NC, as listed in Section D.2.1.10.

D.2.1.6 Naval Weapons Station (NWS) Concord, Concord, CA

Concord NWS is located on the western edge of Suison Bay, an esturine area carrying the flows of the Sacramento and San Joaquin Rivers to San Pablo Bay through the Straits of Carquinez. By sea, the transit is approximately 55 km (35 mi) northeast of the Golden Gate Bridge. Concord NWS is about 5 km (3 mi) north of the city of Concord, CA. The wharf at Concord NWS is about 8 km (5 mi) north of the city. The site tidal areas surrounding the pier areas (including small off shore islands) comprise about 3,1000 ha (7,648 acres) to provide a large separation from nearby communities, and security for the site. A map of the area is shown in Figure D-27. Concord NWS is aligned under the Pacific Division Division of the Naval Ordnance Center. Concord NWS is aligned under the Pacific Division of the Naval Ordnance Center. The Pacific Division is located at Seal Beach, CA and the Naval Ordnance Center is located at Indian Head, MD (Yocum, 1994b).

The Station currently is a breakbulk facility (primarily munitions, naval ordnance, and other high explosives), with limited container handling capabilities. Most vessels servicing the facility are self-supporting, with on-board cranes for handling cargo. Concord NWS currently has a 100-metric ton (112-ton) floating crane and a truck mounted mobile 82 metric ton (90 ton) crane used to service the Station as needed (several cranes are mounted on a crane ship that ties up alongside cargo vessels and loads or offloads cargoes). The facility also has a roll-on/roll-off berth for stern ramps, and a substantial barging pier. A $57 million modernization program has been approved for completion by 1999, which will add to Pier 3 two new 36 metric ton (40 ton) container cranes and gantry crane rails outside of the existing pier structures. The improvements will permit more efficient handling of containerized cargo. The Station is very similar to the MOTSU facility, with three well-separated wharves with two berths on each [about 360 m to 370 m long (1,180 ft to 1,220 ft) at Pier 3]. Separation is designed to protect adjacent vessels from severe damage (or additional explosions) in the unlikely event of an explosion on one ship. Like MOTSU, each pier has three parallel rail lines. Depth alongside the breakbulk/container wharves is 10.6 m (35 ft) at mean low water, which is adequate for most breakbulk/container vessels. Vessel size is limited by the height limit of 33 m (135 ft) under the bridges over the Strait, and the width of the channel [about 90 m (300 ft) minimum] (Yocum, 1994a and 1994b).

Truck access to Interstate 680 is about 10 km (6 mi) via State Route 4. The site has about 127 km (79 mi) of paved roads and 165 km (103 mi) of rail tracks. Concord NWS is served by the Union Pacific, Southern Pacific, and Santa Fe Railroads (all of which have mainline tracks through the tidal area) and has the equivalent of a small intermodal railyard in the immediate vicinity of the pier where railcars can be brought after loading on the piers. Rail routes include direct movement to the Hawthorne Army Ammunition Depot in Hawthorne, NV, where spent nuclear fuel could be off-loaded to trucks for direct shipment to the Nevada Test Site (Yocum, 1994b).

Other Pertinent Information: Since it is a military facility and an explosives operating area, the entire pier operations waterfront is surrounded by barbed wire fencing with access through military posted gates. The facility has areas for staging (and short-term secure storage) shipments by truck or rail near the pier areas.

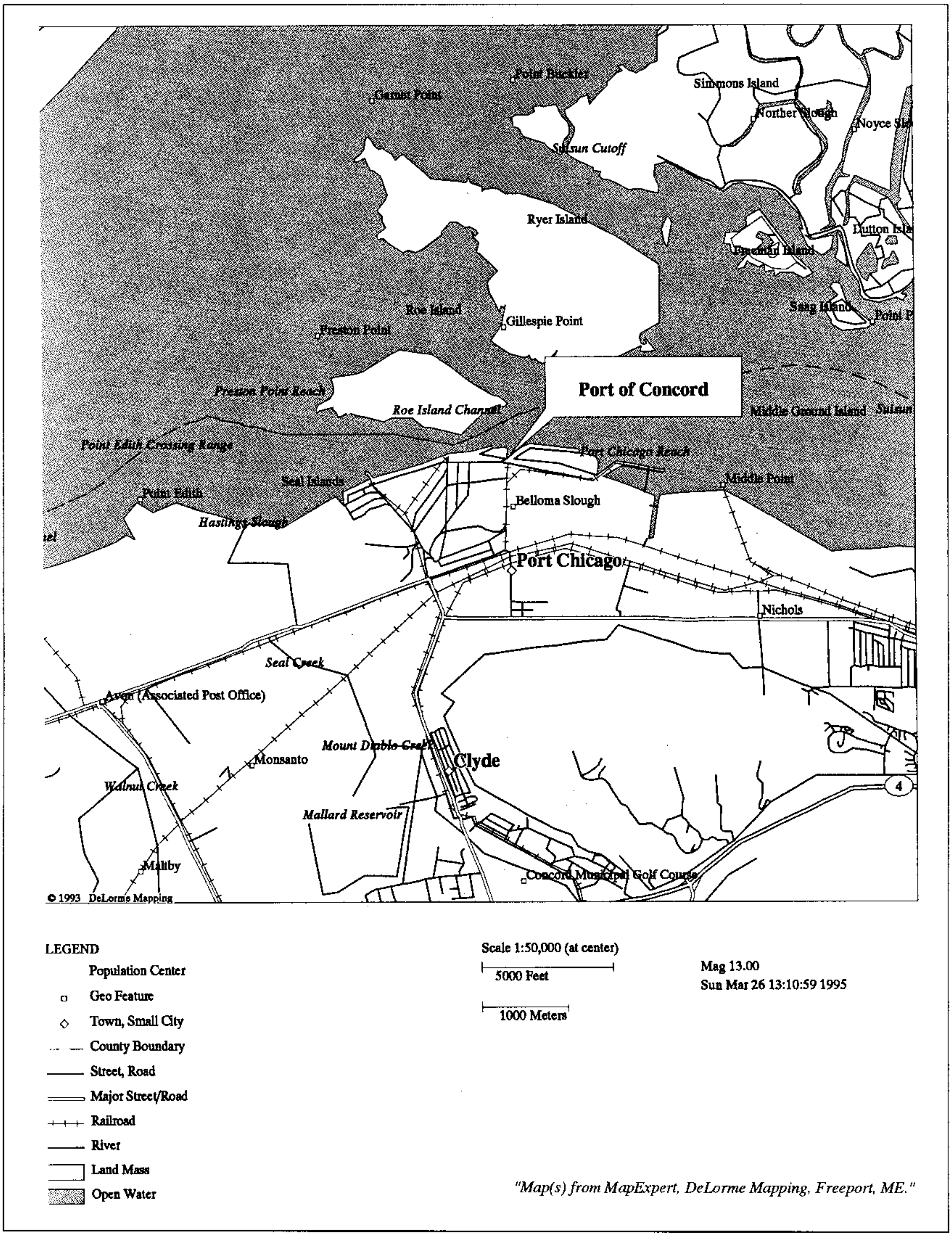


Figure D-27 Map of the Concord Naval Weapons Station, Concord, CA

When explosives are being handled, the explosive safety arc is approximately 3,400 m (11,200 ft) around the pier area. The existing State highway through the site is closed off about 3 km (2 mi) from the piers at the small town of Clyde (population about 485) adjacent to the Station's Administrative areas (Yocum, 1994b). Concord NWS area has its own full-time security force, with a U.S. Coast Guard facility onsite to provide some explosive oversight services during loading and unloading activity. There is a fire station in the immediate vicinity of the pier areas, with an estimated 3-minute response time for first responders.

The primary mission of the port is to support all branches of the military in shipping munitions. No concurrent non-explosives cargo handling, such as foreign research reactor spent nuclear fuel, would be allowed when explosives are being handled. Scheduling of foreign research reactor spent nuclear fuel shipments would have to be done for times when no explosives handling is anticipated. Unscheduled activities or activities with little advance notice involving the military mission would require re-scheduling or re-routing of the foreign research reactor spent nuclear fuel. The foreign research reactor spent nuclear fuel handling would not be the first priority of the port.

Conflicting activities are expected to be avoided by proper scheduling (normally only one ship at a time is in port).

Parts of the tidal area are leased to local cattle growers to keep the grass down for fire protection purposes. The station is a wildlife sanctuary for migratory birds (about 1,200 ha or 3,000 acres) of the tidal area) and hosts native Tule elk, which were formerly on the endangered species list (Yocum, 1994b).

The likelihood of severe natural phenomena, such as high winds and earthquakes, is reflected in the structural requirements for buildings in each area of the United States. These are shown in the Uniform Building Code (UBC, 1991). For the Concord NWS, the Uniform Building Code requires buildings to withstand wind speeds up to 110 km/hr (70 mph). The port is located on the edge of a very high seismic zone with an acceleration of 0.45 g.

The 1990 population within 16 km (10 mi) of the port terminals was 381,070. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: Savannah River Site, 1,040,000; Oak Ridge Reservation, 742,000; Idaho National Engineering Laboratory, 271,000; Hanford Site, 263,000; and Nevada Test Site, 437,000. Populations along rail routes to these sites are slightly smaller for Oak Ridge Reservation, Idaho National Engineering Laboratory and Nevada Test Site, and slightly larger for Savannah River Site, and Hanford Site. These populations are shown in Section D.1. The distances to the five potential sites on interstate routes are: Savannah River Site, 4,476 km (2,784 mi); Oak Ridge Reservation, 4,111 km (2,557 mi); Idaho National Engineering Laboratory, 1,516 km (943 mi); Hanford Site, 1,376 km (856 mi); and Nevada Test Site, 1,145 km (712 mi). Distances along rail routes are about the same for Idaho National Engineering Laboratory, and slightly longer for Savannah River Site, Oak Ridge Reservation, Hanford Site, and Nevada Test Site.

Environmental Conditions

Concord NWS occupies 5,233 ha (12,931 acres) of land adjoining south Suison Bay. Of this total acreage, 2,135 ha (5,276 acres) are inland, while 3,097 ha (7,653 acres) are more tidal in nature. Wetlands comprise approximately 1,215 ha (3,002 acres) of the tidal area (Yocum, 1994b). Wetlands occupy large areas of land bordering all sides of Suison Bay and Grizzly Bay, which is located directly north of Suison Bay. The waters of Suison Bay are characterized as a mid-salinity estuarine habitat (generally 5 to 16.5 ppt). Chinook salmon (endangered), steelhead trout, striped bass, sturgeon, and American shad are typically found in this area (FWS, 1981e; FWS, 1981f).

Portions of the inland area at Concord NWS serve as a sanctuary for Tule elk, a formerly endangered species (Yocum, 1994b). Other terrestrial species found in the area include the river otter, the salt-marsh harvest mouse (a Federally protected species), and the white-tailed kite (FWS, 1981e; FWS, 1981f). Adult concentrations and nesting areas of the California clapper rail (a Federally protected bird species) and the California black rail (a State protected species) are also found in this area. The U.S. Fish and Wildlife Service reports that the following Federally-listed, protected species may occur in Contra Costa County: winter-run chinook salmon (endangered), delta smelt (threatened), bald eagle (endangered), American peregrine falcon (endangered), Aleutian Canada goose (threatened), California brown pelican (endangered), California clapper rail (endangered), California least tern (endangered), and the salt marsh harvest mouse (Medlin, 1994). The Federally and State protected figwort plant family is also found in the vicinity of Concord NWS. In general, the greater San Francisco Bay area annually supports large numbers of shorebirds, wintering waterfowl, raptors, seabirds, and passerlings. In addition, shorebirds, wading birds, waterfowl, seabirds, and songbirds migrate through this coastal area.

Climatic Conditions

Currently, there is no operational National Weather Service station located in Concord, CA. However, the National Weather Service does operate stations at the San Francisco International Airport (37° 37' N; 122° 23' W) and at Stockton, CA (37° 54' N; 121° 15' W). Because of the influence of the California Coast Ranges, which exist between San Francisco and Concord (trending northwest-southeast), the National Weather Service data at Stockton, CA, is considered a better surrogate for the climatological conditions at the Concord Naval Weapons Station.

Concord is located on the westernmost edge of the Great Valley of California, in the eastern foothills of the Coast Ranges. The region is comprised of rich agricultural land, located on the broad delta formed by the confluence of the Sacramento and San Joaquin Rivers. Well to the east of this region are the foothills of the Sierra Nevada Mountains and to the west are the California Coast Ranges. The coast ranges are important in providing an effective barrier from the maritime air masses that greatly influence the San Francisco-Oakland area. However, several gaps in the Coast Ranges do permit the inland migration of the sea breeze circulation, which tends to moderate daytime high temperatures in the summer months. In general, the area is characterized in summer by warm, dry days and relatively cool nights with clear skies and little rainfall. Winter brings relatively milder temperatures, with light precipitation and frequent heavy fog events, which often have long durations in December and January. Ninety percent of the precipitation falls between November and April, with thunderstorms extremely infrequent (4 days per year) and snowfall almost nonexistent (NOAA, 1992j).

D.2.1.7 Portland, OR

The Port of Portland is located about 160 km (97 mi) above the mouth of the Columbia River on the Willamette River tributary. Portland is the principal city of the Columbia River system and one of the major ports on the Pacific Coast. The preferred container terminal (T6) is located approximately 170 km (90 mi) from the entrance of the Columbia River. Federal project depths in the Columbia River are 14.6 m (48 ft) over the bar, and 12 m (40 ft) to Portland (DOC, 1992b). However, a port official indicated the actual channel depth is 13.11 m (43 ft), and the channel width is 183 m (600 ft) from the coast to the port (Magness, 1993).

There are a number of cautions concerning entering and navigating the Columbia and Willamette Rivers. The U.S. Coast Pilot warns that entry into the Columbia River can be dangerous because of sudden and unpredictable changes in the currents often accompanied by breakers. It is reported that "ebb [tide] currents on the [North] side of the bar attain velocities of [3.1 to 4.2 meters-per-sec] 6 to 8 knots . . . In the entrance the currents are variable, and at times reach a velocity of [2.6 meters-per-sec] 5 knots on the ebb; on the flood [tide] they seldom exceed [2.1 meters-per-sec] 4 knots. Since logging is one of the main industries of the region, free floating logs and submerged deadheads or sinkers are also a source of danger. The danger is increased during spring freshets" (DOC, 1992b).

U.S. Coast Guard statistics for 1990 through 1993 indicate that the transit from the Pacific Ocean to the Port of Portland is hazardous, with a reported total of 112 ship collisions and 145 (hard) groundings (USCG, 1994b). It is noted that a large number of oceangoing vessels make the transit on a routine basis without incident. Since some of these accidents were most likely associated with barges, it is believed that the actual rate for oceangoing vessels is probably lower.

The Port of Portland owns and operates Terminal T6, a deep-water dedicated container facility located on Pearcy Island, at the confluence of the Columbia and Willamette Rivers, about 140 km (90 mi) from the ocean entrance to the Columbia River. The port also owns other terminals (including T2, a container/breakbulk facility), all of which lie further upstream of Terminal T6. Terminals are situated in an industrial port district northwest and seaward of downtown Portland (POP, 1994). A map of the port is shown in Figure D-28.

The port is served by several container lines including Australia New Zealand Direct Line, Evergreen Line, Hanjin Shipping Co., LTD., Hawaiian Marine Lines, Hyundai, International Marine Transport Lines, Italian Line, d'Amico Line, Jebson's International, "K" Line, Mitsui OSK, Neptune Orient, NYK Line, Pacific Commerce Line, Safbank Line, and United Yugoslav Line (Jane's, 1992; AAPA, 1993; POP, 1994).

Terminal T6: This terminal has three berths, five container cranes [two 36.3 metric ton (40 ton) and one 50 metric ton (55 ton)], a container freight station, distribution warehouse, and rail/barge service. It has about 869 m (2,851 ft) of marginal wharf, with 12.2 m (40 ft) of water alongside at mean low water. Truck access to Interstate 5 is via North Marine Drive and N. Lombard Street, both of which connect with I-5 about 5.5 km (3.4 mi) from the terminal entrance. North Marine Drive is an industrial use roadway that connects with I-84, the assumed route to Idaho National Engineering Laboratory, north and across the Willamette River from downtown Portland. T6 is served by the Burlington Northern and Union Pacific Railroads, whose tracks reach to within about 0.5 km (1,500 ft) of the container berths; an intermodal, container-on-flat-car rail yard is an integral part of the terminal. T6 has reciprocal switching arrangements with the Southern Pacific Railroad (AAPA, 1993; POP, 1994).

T6 is located north (downstream) of the port's other marine terminals and has no apparent conflict with other hazardous cargoes. It is currently operated by the port, but the port is considering an operations contractor for the future (Hachey et al., 1994).

Terminal T2: This terminal has about 833 m (2,730 ft) of marginal wharf, with 12.2 m (40 ft) of water alongside at mean low water, and four container cranes with capacities ranging from 33 metric tons (36 tons) to over 77 metric tons (85 tons). Truck access to Interstate 84 is via Interstate 5 South to U.S. Route 30 West, connecting with I-84 at Maywood Park, a total distance of about 19 km (12 mi). The terminal is served by the Portland Terminal Railroad and the Burlington Northern, and has direct ship-to-rail transfer capability. T2 also has reciprocal switching arrangements with the Southern Pacific (AAPA, 1993; POP, 1994). T2 is located near several large bulk petroleum terminals that are undoubtedly supplied by tankers. Such traffic was not considered to be a major risk factor for the transportation of spent nuclear fuel to Portland. However, because of the potential conflicting uses, Terminal T6 is the preferred facility.

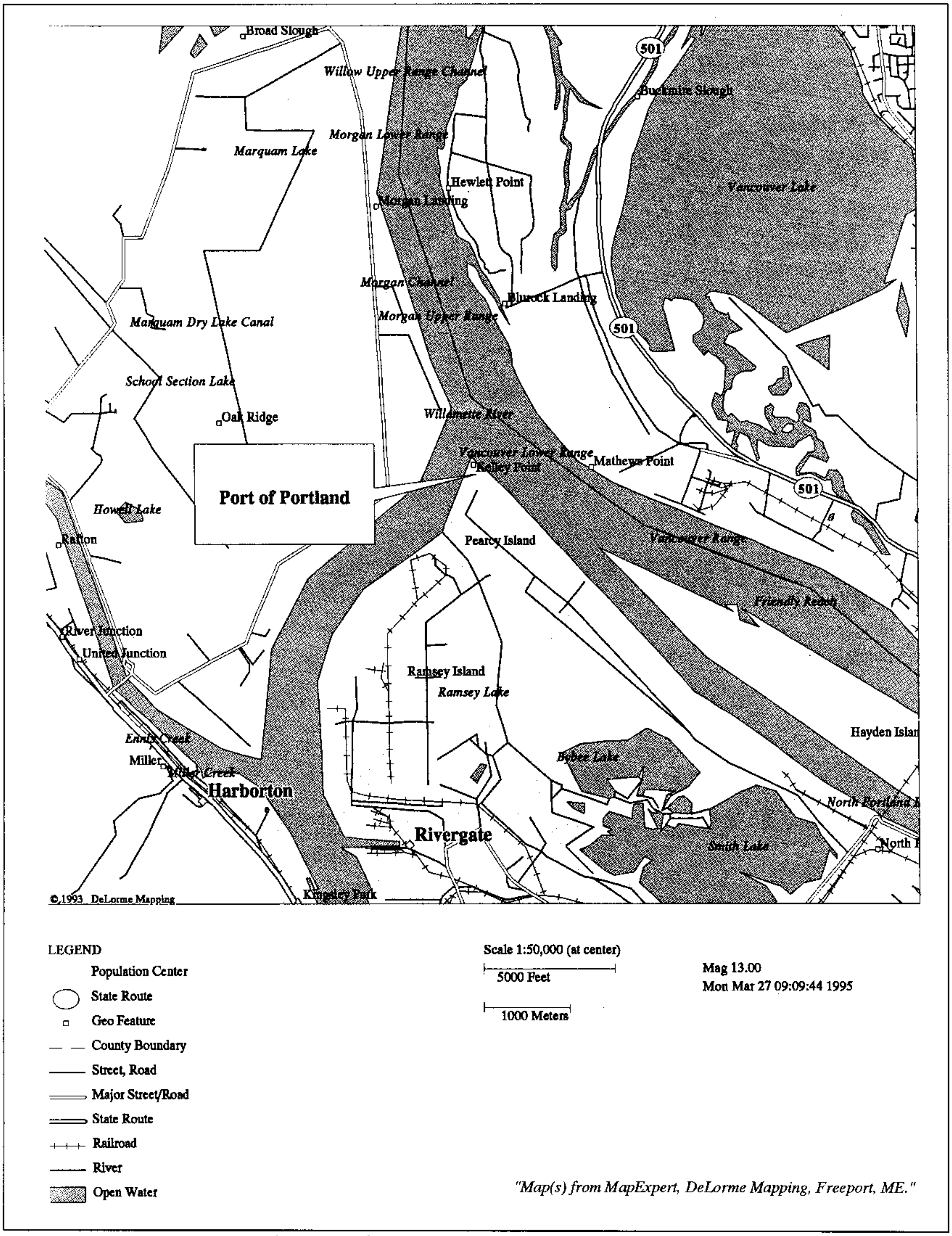


Figure D-28 Map of the Port of Portland, OR

Other Pertinent Information: Security is provided by perimeter fencing and the port's police force, which maintains a 24-hour patrol and surveillance function at both terminals.

There are no restrictive regulations currently affecting the potential receipt and transport of foreign research reactor spent nuclear fuel through the port. The Manager of Marine Market Development indicated that the port has not handled spent nuclear fuel since 1985, and there is opposition to handling nuclear materials by the port's labor unions (Magness, 1993). It is noted that while most of the spent nuclear fuel shipped through Portland had been shipped by the end of 1985, other data sources indicate the port also handled additional spent nuclear fuel in 1989 (NRC, 1993; SNL, 1994). There are no restrictions on Class A or B explosives, and the Coast Guard does not make radiation surveys of radioactive cargoes. Recently, the port could not get shippers to handle naturally radioactive columbium concentrate from British Columbia even if it is not unloaded (Hachey et al., 1994). While this does not preclude foreign research reactor spent nuclear fuel shipments, this indicates there is the potential for delays which could result in failing to "expeditiously transfer" foreign research reactor spent nuclear fuel from the port to a selected storage site.

Portland has a Port Evacuation Plan and a hazardous materials advisory staff (Hachey et al., 1994). The State Health Division with whom the port confers, has a resident nuclear physicist for technical assistance. The port is also a member of the Maritime Fire and Safety Association (an industrial association representing 27 terminal operators) and nine fire departments on the Columbia and Willamette Rivers. The nearest fire station can respond within about six minutes (Hachey et al., 1994). The Association has developed emergency response plans and is implementing a radio communications system covering the entire river system from Astoria to Portland. The City fire department and Coast Guard respond to accidents involving hazardous materials cargoes. Port operating personnel and longshoremen receive general instruction concerning handling of hazardous materials cargoes (Magness, 1993). In addition, the port has contractors ready to respond to hazardous materials accidents when necessary (Hachey et al., 1994). There has not been a severe container accident in at least 10 years, so no port accident statistics were available (Hachey et al., 1994). The port is located several miles downstream from Portland's business and residential districts in an area that appears dedicated to port industrial usage, but as already noted, has excellent connections with highways and rail service.

There are no known areas of special environmental concern in the immediate vicinity of the port, although concern for the environment runs high throughout the Pacific Northwest. A "critical habitat" adjacent to Terminal 6 will have to be mitigated with the planned expansion at T6, but there are no plans to fill wetlands between T6 and populated areas about 1 or 2 km (0.6 or 1.2 mi) away (Hachey et al., 1994).

The port is subject to earthquakes and volcanism. The likelihood of severe natural phenomena, such as high winds and earthquakes is reflected in the structural requirements for buildings in each area of the United States. These are shown in the Uniform Building Code (UBC, 1991). For the Port of Portland, the Uniform Building Code requires buildings to withstand wind speeds up to 140 km/hr (90 mph). The port is located in a moderate seismic zone with an acceleration of 0.20 g. There have been two major earthquakes in the Puget Sound area this century; a Modified Mercalli Intensity (MMI) VIII on April 13, 1949, and an MMI VII-VIII on April 29, 1965 (Bolt, 1978). On May 18, 1980, nearby Mount St. Helens suffered a major volcanic eruption (IPA, 1993). All the mountains along the Cascade Range are volcanic in origin and prone to eruption (Foster, 1971; Hamilton, 1976; IPA, 1993).

The 1990 census population within 16 km (10 mi) of the Terminal was 356,064. The affected populations within 0.8 km (0.5 mi) of the interstate routes to the five potential DOE management sites are: Savannah River Site, 686,000; Oak Ridge Reservation, 519,000; Idaho National Engineering Laboratory, 143,000; Hanford Site, 85,700; and Nevada Test Site, 375,000. Populations along rail routes to these sites are slightly smaller for Nevada Test Site and Idaho National Engineering Laboratory, but slightly larger for Savannah River Site, Oak Ridge Reservation, and Hanford Site. These populations are shown in Figures D-8 through D-17 in Section D.1. The distances to the five potential sites on interstate routes are: Savannah River Site, 4,630 km (2,879 mi); Oak Ridge Reservation, 4,200 km (2,609 mi); Idaho National Engineering Laboratory, 1,190 km (738 mi); Hanford Site, 407 km (253 mi); and Nevada Test Site, 2,040 km (1,270 mi). Distances along rail routes are slightly longer, with the exception of Hanford Site, which is slightly less.

Environmental Conditions

The areas surrounding the Terminal are in river-oriented industrial land use. Wildlife habitat along the Oregon Slough is limited because of the industrial development, although some waterfowl use the area. While the primary uses in the Terminal area are commercial navigation and industry, some recreational fishing and boating occurs in Oregon Slough and the Columbia River (Kurkoski,1994).

The U.S. Fish and Wildlife Service's Ecological Inventory for the Vancouver, Washington-Oregon area indicates that the Columbia River generally includes the following fish species: salmonids, chinook salmon, coho salmon, chum salmon, pink salmon, sockeye salmon, steelhead trout, Dolly Varden, smelts, river lamprey, white sturgeon, American shad, eulachon, and cutthroat trout (FWS, 1981d). South of Portland, the various islands and wetlands along the Columbia River provide habitat for a wide variety of terrestrial organisms. Areas of special interest include the Sauvie Island Game Management Area, which is located approximately 8 km (5 mi) downriver of Terminal 6, and the Ridgefield National Wildlife Refuge, which is approximately 16 km (10 mi) downriver.

The U.S. Army Corps of Engineers reports that raptors such as the red-tail hawk, bald eagle, and peregrine falcon are occasional visitors to this area and that the U.S. Fish and Wildlife Service has indicated that the endangered American peregrine falcon and threatened bald eagle may winter in this area. In addition, the National Marine Fisheries Service has listed the Snake River sockeye salmon as endangered, and two Snake River chinooks stocks as threatened (Kurkoski, 1994). The State of Oregon's Natural Heritage Program reports that there are at least two rare species that occur in the vicinity of Terminal 6 (Gaines, 1994). These species are the painted turtle (a State-Sensitive-Critical species) and the Columbia water-meal.

Climatic Conditions

The city of Portland is situated midway between the northerly oriented low coast range on the west and the higher Cascade range on the east. The Cascade range provides a steep slope for orographic uplift of moisture laden air arriving on westerly winds from over the Pacific Ocean, resulting in moderate rainfall events in the area. The prevailing winds are generally northwesterly during spring and summer, becoming more southeasterly in fall and winter. The Portland area is characterized by a winter rainfall regime, where approximately 88 percent of the annual total falls during October through May. Thus, the winter season is dominated by relatively mild temperatures, cloudy skies and rain accompanied by southeasterly surface winds. Summer produces pleasantly mild temperatures, northwesterly winds and very little precipitation. Fall and spring are traditional seasons with variable characteristics. Fog generally occurs most frequently during fall and early winter. Destructive storms are infrequent in this region of the United States, and surface winds rarely exceed gale force. Thunderstorms occur monthly through the spring and summer, with gentle rains occurring almost daily during the winter months. Based on the 1951-1980 climatology, the first frost occurs on average around November 7, with the last spring frost occurring near April 3 (NOAA, 1992f).